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PARKER (K. G.), COLLINS (D. L.), TYLER (L. J.), CONNOLA (D. P.), OZARD (W. E.), & DIETRICH (H.). **The Dutch Elm disease : association of Ceratostomella ulmi with Scolytus multistriatus, its advance into new areas, method of determining its distribution, and control of the disease.**—*Mem. Cornell agric. Exp. Sta.* 275, 44 pp., 1 map, 1947. [Received August, 1948.]

Studies carried out at Cornell University during a period of 11 years from 1934 (including field work in areas where Dutch elm disease was well established and at the periphery of its known occurrence as it moved northward up the Hudson River Valley) showed that *Ceratostomella ulmi* [*R.A.M.*, 27, p. 301] is generally prevalent on adults of *Scolytus multistriatus* in the lower and central parts of the Valley. The fungus did not become established in all feeding scars made by infested adult beetles, and its establishment did not invariably result in infection. Failure of the fungus to invade sound tissue and produce infection was more marked when the feeding took place later in the season. Not all infected trees wilted, and less invasion occurred following inoculations made after July. Infected twigs frequently died back to a point below the parts invaded, invasion proceeding no farther; this was most commonly noted on trees inoculated in spring. The result was that the number of destructive infections was very small in comparison with the total number of feeding scars made on the twigs by inoculum-bearing beetles.

Severe local outbreaks were invariably associated with wood from which large numbers of bark beetles had emerged. In many cases such wood did not originate in diseased trees, neither had infected trees been present in the vicinity before the outbreaks. Cultures from emerging beetles, however, yielded the fungus. Scattered diseased trees are also frequently associated with a definite source of bark beetles, or such trees may be present in areas where beetle breeding is common. In many instances the disease is not maintained locally, i.e., continued new infections are not made by beetles emerging from diseased trees. A small source of beetles may not induce any infections, but if many such sources are present over a large area infections will probably result. The evidence obtained indicates that *C. ulmi* is introduced into new areas by *S. multistriatus* during its breeding activities.

Cultures of frass, bark, or wood tissue from larval galleries yielded the fungus as readily as beetles from infested logs, frass being the easiest material to handle. This method might be used for making extensive surveys for the pathogen in new areas before the disease becomes established or for making intensive local surveys in infected areas to determine prevalence of the fungus in naturally occurring material infested with scolytid beetles.

It is suggested that control is feasible by properly applied sanitary measures designed to prevent the emergence of bark beetles near valuable trees. The results of a preliminary programme of this nature indicate that a high degree of success may be expected from its utilization. The size of the area that must be kept clean in this manner to secure adequate control must be determined by experience, but as a beginning beetle-infested wood within a radius of 500 to 1,000 ft. of the trees

to be protected should be removed, depending on the amount of such wood and the elm population.

Spaulding (P.). **The role of Nectria in the Beech bark disease.**—*J. For.*, 46, 6, pp. 449–453, 1 fig., 1 map, 1948.

This is a summary and discussion of the available information on the action, known distribution, probable introduction from Europe, present status, and anticipated future spread of *Nectria coccinea* (*Mycologia*, 33, pp. 178–187, 1 fig., 1941) var. *faginata* [*Index of Fungi*, p. 90] in relation to the beech bark disease of the Canadian Maritime Provinces [*R.A.M.*, 22, p. 185], Maine, and New Hampshire. A brief note is also given on the importance of beech in northern New England.

Cole (J. R.). **Zinc dimethyldithiocarbamate (zerlate or karbam white). A promising fungicide for Pecan scab control.**—*Phytopathology*, 38, 11, pp. 921–922, 1 fig., 1948.

Tests were carried out in 1947 at Albany, Georgia, to determine the relative efficiency of zerlate (2–100) and Bordeaux mixture, each of them with or without 1 qt. Du Pont spreader-sticker in pecan scab (*Cladosporium effusum*) control on the Schley variety [*R.A.M.*, 28, p. 95], using nine trees per test. Bordeaux was used at a strength of 4–1–100 for the initial application (when the first leaves formed were half grown and before pollination) and at 6–2–100 for the second (soon after the completion of pollination or when the tips of the small nuts had turned brown), third (three to four weeks later), and fourth (after a further three to four weeks).

Although the Bordeaux-treated trees gave the heaviest nut yields (40 lb. per tree without the spreader-sticker and 32 with it, compared with 34 and 30, respectively, for similar tests with zerlate and 1 for the controls), the zerlate-sprayed trees produced the heaviest individual nuts with the highest percentages of kernel. The foliage was a healthier green on the trees sprayed with zerlate during the late summer and early autumn than on the Bordeaux-treated or checks. The black pecan aphis (*Melanocallis caryaefoliae*) population was more abundant on the Bordeaux- than on the zerlate-sprayed trees, both groups harbouring more insects than the controls.

Abrahão (J.). **Botrytis cinerea Pers. parasitando mudas de Eucalyptus spp.** [*Botrytis cinerea* Pers. parasitizing transplants of *Eucalyptus* spp.]—*Biológico*, 14, 7, p. 172, 1948.

Botrytis cinerea was observed in September, 1947, attacking transplants of *Eucalyptus citriodora*, *E. botrioides*, and *E. alba* in hothouses at the Biological Institute, São Paulo. This is the first record of the fungus on the hosts in question for Brazil, though it has recently been reported on *E.* [*rostrata*] in Argentina [*R.A.M.*, 26, p. 516; 27, p. 312]. The shrivelled, rolled, drooping leaves were covered with the pathogen, which was readily isolated in culture. Inoculation experiments in April, 1948, with spore suspensions on 10-month-old transplants of ten species gave positive results on six, viz., *E. saligna*, *E. tereticornis*, *E. punctata*, *E. robusta*, *E. longifolia*, and *E. trabuti*.

Childs (T. W.) & Bedwell (J. L.). **Susceptibility of some White Pine species to Cronartium ribicola in the Pacific Northwest.**—*J. For.*, 46, 8, pp. 595–599, 1948.

The results of tests on 5,210 white pine trees planted in Oregon and British Columbia and examined annually for periods of 5 to 11 years indicated the following order of susceptibility to *Cronartium ribicola*: resistant, *Pinus armandi*, *P. griffithii*, and *P. koraiensis*; moderately susceptible, *P. aristata* and *P. peuce* [*R.A.M.*, 28, p. 148]; susceptible, *P. flexilis* and its var. *reflexa* and *P. strobus*; very susceptible, *P. monticola*; and exceedingly susceptible, *P. lambertiana* (although a

few trees of the last-named species were still uninfected after more than ten years' exposure to the rust under optimal conditions for its development). *P. albicaulis* appears from earlier observations [ibid., 23, p. 198] to be the most susceptible member of the genus.

HIRT (R. R.). **Evidence of resistance to blister rust by eastern White Pine growing in the northeast.**—*J. For.*, 46, 12, pp. 911–913, 1948.

Details are given of a number of individual eastern white pine (*Pinus strobus*) trees in New York State which have either resisted blister rust (*Cronartium ribicola*) infection or recovered from the disease. For instance, in 1947 two trees which contracted infection in 1927 at the age of four years were still alive and the rust was active in the large basal trunk cankers. Sufficient callus had been formed round the infected areas to permit of survival and the addition of a fair amount of growth, denoting a high degree of tolerance or resistance [cf. preceding abstract]. Other cases of survival after exposure to infection between 1927 and 1934 are under observation, and if their promising reactions should be maintained in future tests an increase of stock is planned for the establishment of plantations [cf. *R.A.M.*, 25, p. 429].

WELLNER (C. A.). **New disease threatens Western White Pine stands.**—*J. For.*, 46, 4, pp. 294–295, 1948.

Information already published concerning the inroads of pole blight in 40- to 100-year-old western white pine [*Pinus monticola*] stands in five national forests of the United States is recapitulated [*R.A.M.*, 27, p. 210]. Intensive studies on the disease have been made under the auspices of the University of Idaho and plans are in hand for their continuation. In the Cœur d'Alene forest 38,000 of the total 108,000 acres of pole-sized white pine are already damaged, and a further 24,000 are under suspicion. In the Inland Empire, trees of the requisite size for poles are scarce, and the further spread of the blight would constitute a serious threat to production.

DOOLITTLE (W. T.). **White Pine blight in relation to site and thinning.**—*J. For.*, 46, 12, pp. 928–929, 1 graph, 1948.

In March, 1947, observations on eastern white pine (*Pinus strobus*) needle blight [attributed in Canada to *Pullularia pullulans* following injury by a gall midge: *R.A.M.*, 9, p. 500; 21, p. 356] were made on 360 trees in eight paired plots (thinned and unthinned), four on moist and four on dry sites, in a 50-year-old plantation in North Carolina, where the disease was first observed in 1944. On the moist sites 4·2 per cent. of the unthinned and 9·4 per cent. of the thinned trees were found to be infected, the corresponding figures for the dry ones being 15·2 and 21·7, respectively. A re-grouping of the analytical data according to (*a*) site and (*b*) treatment only showed 18·6 per cent. of the trees on the dry and 5·2 per cent. of those on the wet sites to be affected, the corresponding figures for the thinned and unthinned plots being 14·4 and 5·6 per cent., respectively. Of the total number of trees on the eight plots, 28 (7·8 per cent.) were diseased. For the five-year period prior to 1947 the growth rate of the blighted trees had been reduced by 33·5 per cent. compared with that of normal trees.

KRASILNIKOV (N. A.) & RAZNITSINA (Mme E. A.). **A bacterial method of controlling damping-off of Scots Pine seedlings caused by Fusarium.**—*Agrobiologiya, 1946*, 5–6, pp. 109–121, 1946. [Abs. in *For. Abstr.*, 10, i, pp. 120–121, 1948.]

In 1938, *Pinus sylvestris* seedlings in the Botanical Gardens of the Academy of Sciences of the U.S.S.R. [? Leningrad] were severely affected by damping-off, caused by a virulent species of *Fusarium* [*R.A.M.*, 14, p. 68; 26, p. 138]. Of more than 200 strains of bacteria tested for possible antagonism to the pathogen, 17

induced dissolution of the fungal hyphae in two to five days; some strains acted similarly, but more slowly, and some only retarded fungal growth. As hyphal autolysis can occur without bacteria and hyphae artificially killed are not dissolved in their presence, it is suggested that the active strains may exert their effect by inhibiting the activity of the fungus to a point where autolysis is brought about by the enzymes of the fungus.

In 1939–40, *in vitro*, pot, and box cultures and field experiments were carried out using suspensions of the bacteria, 'bacterialized' composts, or 'bacterialized' peat, with seed either artificially infected with *Fusarium* or grown in heavily infested soil. In the laboratory tests the optimum results were obtained when the seeds were infected almost simultaneously with both the fungus and the bacteria. Only six strains (of the genera *Pseudomonas* and *Achromobacter*) were sufficiently effective, the most active being No. 30 (*Pseudomonas* sp.) from 'zhitnyak' [? barley] compost and No. 77 [unidentified] from 'bacterialized' peat. In all trials, treatment with these strains or with 'zhitnyak' compost gave the best results, reducing disease incidence and death rates by 70 to 90 per cent. The germination and growth of the seedlings also appeared to be stimulated. This was confirmed in tests in which *Fusarium* was excluded, strain No. 30 or 'zhitnyak' compost (in which the strain is abundant) being the best stimulants.

The evidence suggests that the bacterial method may become useful in the control of damping-off, but further studies are required.

Van Vloten (H.). **Phomopsis pseudotsugae op Japanse Lariks.** [*Phomopsis pseudotsugae* on Japanese Larches.]—*Ned. Boschbouw-Tijdschr.*, 20, 3, pp. 67–71, 1948.

In connexion with recent observations on the occurrence of *Phomopsis pseudotsugae* on Japanese larches [*R.A.M.*, 26, p. 222; 27, p. 546] in North Brabant and the Veluwe, Holland, the writer summarizes the available information on the disease.

Nomenclature and definitions of wood preservatives and wood coatings.—*Paint Varn. Prod. Mgr*, 28, 11, pp. 330–332, 1948.

Because of ambiguity in the use of names for certain preservatives and wood coatings, the National Door Manufacturers' Association [United States] has adopted names and definitions for five different kinds of products which its members are liable to confuse. They are briefly as follows. 1. N.S.P. (non-swelling, paintable) water-repellent for wood is a fluid that penetrates and continues for some time to spread into wood even when applied by non-pressure methods and, after drying, materially retards changes in moisture content and dimensions without adversely affecting any of the essential properties of the wood.

2. Wood sealer. This is a kind of varnish or lacquer that penetrates into the wood just enough to avoid coating the surface appreciably and, on drying, leaves the lumina of the wood cells and pores nearest the surface largely occupied by its non-volatile ingredients.

3. An N.S.P. preservative for wood is a penetrating fluid imparting resistance to infection by fungi or insects without adverse effects on essential properties. For this purpose are used relatively non-volatile fungicides or fungicidal mixtures of low solubility in water, e.g., pentachlorophenol, tetrachlorophenol, trichlorophenol, chloro-ortho-phenyl phenol, or copper naphthenate in a volatile, non-aqueous solvent, such as mineral spirits.

4. A preservative wood sealer is a combination of (2) and (3).

5. An N.S.P. water-repellent preservative for wood combines the characteristics of (1) and (3). N.S.P. preservatives are commonly applied by the dipping process, in which absorption by the wood can be controlled within certain limits by varying the time of submergence.

Markham (R.) & Smith (K. M.). **Studies on the virus of Turnip yellow mosaic.**—*Parasitology*, 39, 3–4, pp. 330–342, 7 pl., 1 diag., 3 graphs, 1949.

This is an expanded account of studies on the turnip yellow mosaic virus [*R.A.M.*, 27, p. 303]. The disease occurs naturally on turnips, swedes, and broccoli in the vicinity of Bristol and Edinburgh, and is also common in Portugal. The virus has also been transmitted experimentally to radish, cabbage, Chinese cabbage, kohl-rabi, mustard, *Brassica carinata*, *B. juncea*, *B. arvensis*, watercress, and *Capsella bursa-pastoris*. It is sap-transmissible and has a dilution end point in extracted sap of 10^{-5}. The thermal inactivation point lies between 70° and 75° C. The insect vectors in nature are flea-beetles (*Phyllotreta* spp.), and *P. undulata*, *P. cruciferae*, and *P. nemorum* were shown by transmission tests to be among those implicated, while other biting insects giving positive results were *Phaedon cochleariae*, *Leptophyes punctatissima*, *Stauroderus bicolor*, and *Forficula auricularia*.

The virus has been obtained from several of its hosts as a nucleoprotein of the pentose type, crystallizing from salt solutions as isotropic octahedra and from 20 per cent. alcohol at pH 3·7 as birefringent needles. On centrifuging out of solution the pellets also are crystalline. The virus preparation contains some 22 per cent. nucleic acid. The virus is denatured at room temperature in alcohol at a concentration exceeding 30 per cent. in neutral solutions, and the nucleic acid, a large polymerized particle, is liberated. The preparations have been found to consist of 80 per cent. of a nucleo-protein and 20 per cent. of a nucleic acid-free protein which may be isolated by high-speed centrifuging. The latter has the same electrophoretic motility and isoelectric point (pH 3·7) as the nucleoprotein; both crystallize in the same form and are serologically identical. The nucleic acid-free material appears to be non-infectious.

Butler (J. B.). **Control of dry rot. Architectural design and building practice.**—Reprinted from *Irish Build. Engr*, 2 pp., 4 figs., 1943. [Received, 1948.]

In this article dealing with some of the more unusual predetermining factors leading to the development of dry rot (*Merulius lacrymans*) [*R.A.M.*, 26, p. 572] in buildings in Ireland, the importance of removing underground roots of trees from the building site is emphasized as they constitute a definite source of infection. A porous concrete floor which has not been well tamped affords easy ingress to the fungus strands. A border of flowers or shrubs immediately adjacent to an outer wall is a source of danger as the earth containing fungus strands may extend above the damp-proof course and cover the under-floor ventilators or ventilation may be partially or completely occluded by the plant growth. The extensive growth of ivy or virginia creeper, especially on walls with a northern aspect, is particularly dangerous since dry rot may develop in the accumulation of dead leaves, extend through the wall, and affect the house. The hyphae of *M. lacrymans* were found by the author on one occasion in ivy roots which were extending through the wall. Fungus strands have been recorded as travelling along a rolled steel joist for a distance of 10 ft. The author has traced the strands for at least 15 ft. from the nearest timber through a solid brick wall. An irrigation method introduced by the writer for destroying the fungus is reserved for a subsequent article.

Apart from fungicidal treatment, however, the substitution of steel for all old timber is recommended. Ample ventilation should be provided and ingenious methods of effecting this by holes in the skirting-boards are described, permitting circulation of the air owing to thermo-syphon action. For drying damp walls which are not provided with a damp course the author recommends cutting a series of openings in the wall, the cavities extending about half-way through the wall and the base of the cavity filled with cement and sloped to aid the escape of rain.

Severin (H. H. P.) & Tompkins (C. M.). **Aphid transmission of Cauliflower mosaic virus.**—*Hilgardia*, 18, 11, pp. 389–404, 2 pl., 1 fig., 1948.

In studies carried out in California on the aphid transmission of the cauliflower mosaic virus [cf. *R.A.M.*, 24, p. 403; 27, p. 269], tests with aphids which do not breed on cauliflower plants under natural conditions demonstrated that infection was more readily transmitted by *Macrosiphum pisi*, *Aphis apii*, *Myzus circumflexus*, and *Cavariella capreae* than by the species that do breed on cauliflower, and less readily by *A. apigraveolens*, *A. ferruginea-striata*, *A. gossypii*, *A. middletonii*, *Myzus solani*, and *Rhopalosiphum conii*.

Of three aphid species which breed on cauliflowers under natural conditions, *Brevicoryne brassicae* was a more efficient vector in single-insect tests than *R. pseudobrassicae* or *Myzus persicae*.

Whenever high populations of *B. brassicae* were found on infected cauliflower plants, lots of 20 aphids were transferred to healthy cauliflowers and annual stocks (*Matthiola incana* var. *annua*); the virus was thus obtained from seven different localities in five counties of California. *B. brassicae* transmitted the virus to 67 per cent. of the cauliflower and 43 per cent. of the annual stock plants, and also transmitted it from naturally infected Brussels sprouts to healthy cauliflower seedlings.

Of 21 cauliflower varieties tested, none was resistant to experimental infection by *B. brassicae* or *Myzus persicae*. Mechanical inoculation (carborundum method) was more efficient than transmission by *B. brassicae*, *R. pseudobrassicae*, or *Myzus persicae*. Each of these three species transmitted the virus from diseased to healthy cauliflower during the first day's transfer, but none during the second or third day. When each of three lots of 20 wingless mature aphids of these three species reared on mosaic-infected cauliflower plants was transferred hourly to ten successive healthy cauliflower plants, two of three lots of *B. brassicae* transmitted the virus during the first and second hours and one lot during the first hour only. Each lot of the other two species effected transmission during the first hour only. Aphids acquired the virus in 15 to 25 minutes on a diseased cauliflower plant (five to ten minutes' actual feeding time) and transmitted it in feeding periods of five or ten minutes. In tests with short feeding periods most transmissions occurred during the first ten minutes after transfer.

B. brassicae and *Myzus persicae* recovered the virus from inoculated cauliflower plants many days before the first symptom appeared. Mechanical inoculation of healthy cauliflower seedlings and annual stock with centrifuged virus from crushed, infective *B. brassicae* aphids infected 18 per cent. of the plants.

D'Oliveira (Maria de L.) & Borges (Maria de L. V.). **Estudos dos virus das cruciferas. III. Estirpes isoladas de Brassica oleracea L.** [Studies on crucifer viruses. III. Strains isolated from *Brassica oleracea* L.]—*Agron. lusit.*, 7, 4, pp. 317–335, 1 pl., 1945. [English summary. Received March, 1949.]

Continuing their studies on crucifer viruses [*R.A.M.*, 25, p. 67], the authors collected material from 46 plants of several cabbage varieties showing symptoms of virus infection in various parts of Portugal at different seasons over a three-year period. Greenhouse inoculation experiments by mechanical methods on healthy cabbage plants resulted in 25 virus 'cultures', falling into eight groups mutually distinguishable by the reactions they induce in nine differential hosts. Of these only four are essential for the differentiation of the cabbage viruses, namely, either White Burley tobacco or *Nicotiana glutinosa*, *Matthiola incana* var. *annua* [see preceding abstract], radish, and *Sinapis* [*Brassica*] *juncea*. Four of the viruses, B5, B6, B7, and B8, infect both tobacco and *N. glutinosa*, producing necrotic local lesions on the former and systemic infection on the latter, while the other four are unable to attack these hosts. Virus B1 was transmissible only to cabbage, which

reacted by a very mild vein-clearing, while the host range of the others varied, B8, for instance, being able to infect all the differential hosts comprising, besides the above-mentioned, wallflower, *Malcomia maritima*, and turnip. The wider the host range of an individual virus, the more extensive was its distribution in the country.

The difficulty of identifying the writers' differential hosts with those used by other workers precludes a reliable comparison of the Portuguese viruses with those responsible for the diseases described from other countries. However, a certain similarity is recognized between the cabbage black ring spot and ring necrosis viruses reported from the United States [ibid., 18, p. 364; 20, p. 507] and B6 and B8 of the present studies. Of the crucifer viruses previously investigated in Portugal, only one, G9 from *Matthiola incana* var. *annua*, was able to attack cabbage. This virus appears to be very similar to, or identical with, B4, isolated only once from cabbage in these investigations.

Miller (P. W.) & McWhorter (F. P.). **A disease of Cabbage and other crucifers due to Cercosporella brassicae.**—*Phytopathology*, 38, 11, pp. 893–898, 3 figs., 1948.

This is an amplified account of the disease of cabbage, bird rape or wild mustard (*Brassica campestris*), and turnip caused by *Cercosporella brassicae* (syn. *C. albomaculans*) [*R.A.M.*, 24, p. 44] in Oregon, a preliminary note on which has already appeared [ibid., 24, p. 217]. The mycelium in both cabbage and turnip leaves is predominantly intercellular. In turnip the protoplasts and cell walls in the invaded areas are destroyed, resulting in a necrotic type of lesion, but in cabbage the cellular disorganization is more restricted. The paths of the lateral hyphae are delimited by black, necrotic masses formed from the middle lamella and abutting cell wall. The adjacent cells are partially emptied, but the protoplasts of those more distant from the advancing hyphae are only yellowed, with masses of lipoid elements present as free oils or held in large, vacuolate elaioplasts. The localization of the killed areas explains the dendritic pattern of the lesions.

Wilson (R. D.) & Waring (E. J.). **Some observations and experiments concerning the role of molybdenum in the nutrition of the flowering plant.**—*J. Aust. Inst. agric. Sci.*, 14, 3, pp. 141–145, 2 figs., 1948.

In tests carried out in 1948 in the Central Coast area of New South Wales, intervenal, chlorotic leaf tissue from cauliflowers showing this type of mottling (considered by the authors to be an early stage of whiptail) [due to molybdenum deficiency: *R.A.M.*, 27, p. 400] gave a strong positive reaction with diphenylamine-sulphuric acid indicating the presence of abundant nitrates, while normal green tissue on the same plant gave no reaction or only a very faint blue.

Treatments of affected plants with an aqueous solution of sodium or ammonium molybdate at 0·025 to 0·2 gm. per plant resulted in the disappearance of the nitrate or other oxidizing materials in the younger chlorotic leaves within two and a half to five days; the formation of healthy, green colour followed in about five to seven days. The untreated controls continued to give a strong nitrate reaction.

It is concluded that molybdenum acts as a catalyst in the reduction processes of the cauliflower plant, probably in the reduction of nitrates.

Warren (J. R.). **A study of the Sugar Beet seedling disease in Ohio.**—*Phytopathology*, 38, 11, pp. 883–892, 1948.

Based on the frequency of isolation (111 out of 689 isolates or 15·9 per cent.), *Aphanomyces cochlioides* is the fungus primarily responsible for black root of beets [*R.A.M.*, 27, pp. 4, 402] in Ohio. This fact was fully corroborated by the results of identifications in hanging drop cultures, of which 146 out of 210 (69 per cent.) were *A. cochlioides*. *Pythium debaryanum* was isolated 87 times (12·6 per cent.), but in

hanging drop preparations was identified 45 times (21 per cent.), the corresponding figures for *Rhizoctonia* [*Corticium*] *solani* being 52 (7·6 per cent.) and 22 (10 per cent.), respectively. Some of the isolates of the last-named species were among the most virulent, causing reductions in emergence rated at up to 26·6 based on the mean of controls. The average reductions in emergence for 10 isolates of *A. cochlioides*, eight of *P. debaryanum*, and six of *C. solani* were 9·7, 13·5, and 13·6, respectively, and the average post-emergence deaths 6, 2·6, and 2, respectively.

Seasonal variations in the frequency of isolation of the several organisms were negligible. It may be concluded from the results of a temperature-tank phosphate experiment that the incidence of black root due to *A. cochlioides* tends to increase with a rise in soil temperatures from 18° to 24° C. and is higher, despite amendments of superphosphate at 400 or 500 lb. per acre, at 24°, 28°, and 32° than at 20° and 18°. At 28° and 32° the treatments were ineffectual against black root, but at 18°, 20°, and 24° both applications substantially reduced the amount of disease among seedlings. At these temperatures the percentages of plants dead in relation to the total number emerged in the control plots were as follows: no fertilizer, 50, 66·6, and 97; 400 lb. superphosphate, 8·1, 12, and 78·4; and 500 lb., 11·3, 30·9, and 64, respectively. The beneficial effect of the soil amendments at the low temperatures prevailing during the early spring planting season is of great practical significance.

Clinch (Phyllis E. M.) & Loughnane (J. B.). **Seed transmission of virus yellows of Sugar Beet (Beta vulgaris L.) and the existence of strains of this virus in Éire.**—*Sci. Proc. R. Dublin Soc.*, N.S., 24, pp. 307–318, 5 pl., 1948.

In this expanded account of studies on the seed transmission of a disease of sugar beet resembling virus yellows [*R.A.M.*, 27, pp. 211, 345] in Éire, the authors also describe work on two types of yellows, mild and etch [loc. cit.], isolated from commercial sugar beet crops. In sugar beet and spinach seedlings mild yellows causes basal leaves to become tough and yellow, yellowing spreading acropetally in the lower parts of the plant. The chlorotic areas subsequently become necrotic. The primary symptom of etch yellows in sugar beet and spinach is a clearing of the veins in the young developing leaves which become whitish or superficially necrotic. Later symptoms resemble those of mild yellows, except that the chlorosis is more extensive and plant growth more dwarfed. Minute reddish rings or spots on the yellowed leaves appear to be characteristic. Both diseases are readily transmitted by *Myzus persicae* and to a slight extent by *Aphis fabae*, while *Macrosiphum solanifolii* was also found to be a vector. Though etch yellows can affect plants already showing mild yellows, the former is considered to be a strain of the latter.

In young sugar beet leaves displaying vein clearing following infection with etch yellows, the phloem tissues become necrotic and the surrounding parenchymatous cells show hypertrophy and hyperplasia and may eventually collapse.

The wild beet (*Beta maritima*) was found to be susceptible to etch yellows.

Severin (H. H. P.) & Freitag (J. H.). **Outbreak of western Cucumber mosaic on Sugar Beets.**—*Hilgardia*, 18, 14, pp. 523–530, 4 figs., 1948.

During 1940, a serious outbreak of western cucumber mosaic [*R.A.M.*, 25, p. 395; 27, p. 323] occurred on sugar beets near Firebaugh and Mendota, in the middle San Joaquin Valley, California. Economic and ornamental flowering plants and weeds of many species were severely affected. Heavy flights of *Myzus persicae* occurred in the beet fields. A survey of the beet fields in the coastal fog belt in the Santa Clara Valley during the outbreak failed to disclose a single infected beet.

On naturally infected sugar beets the symptoms consist of large, pale yellow, chlorotic areas, white or green veinbanding or interveinal chlorosis, and when infection is systemic, blister-like elevations on younger leaves (frequently accom-

panied by distorted midribs and veins or by outward-rolled leaf margins), and deformed or twisted young leaves. The most important vector to sugar beets is *M. persicae* [loc. cit.]. In experimentally infected beets seven to ten days after inoculation the yellow areas have a chlorotic centre enclosed by a narrow, dark ring. Later each yellow area is surrounded by a green or yellow ring and the centre becomes purple or pink. Inoculation of sugar beets by *M. persicae* and mechanical means gave 20 and 26 per cent. systemic infection, respectively. *Aphis gossypii* is an efficient vector to melons and cucumbers.

The following economic plants were demonstrated to be naturally infected: garden or red beet, Swiss chard (*Beta vulgaris* var. *cicla*), spinach, lettuce, honeydew melon, cucumber, West Indian or bur gherkin (*Cucumis anguria*), tomato, and celery.

SEVERIN (H. H. P.). **Symptoms of additional Cucumber-mosaic viruses on Sugar Beets.**—*Hilgardia*, 18, 14, pp. 531–538, 5 figs., 1948.

The symptoms produced by the experimental infection of sugar beets (in California) with the viruses of celery calico [see next abstract] and common cucumber mosaic are described and compared with those caused by western cucumber mosaic [see preceding abstract].

The first effect of celery calico on the leaves of sugar beet seedlings three to nine days after inoculation (four to 15 days on large beets) is the formation of large, irregular, pale green areas which diffuse into the green tissue; this symptom distinguishes the condition from common cucumber mosaic. Subsequently, the affected areas become circular and yellow, measuring 11 to 15 mm. in diameter, each with a pale, chlorotic centre. Chlorotic veinbanding of part of the midrib and some veins may be present. The chlorosis spreads gradually over the whole leaf. Irregular green, later chlorotic, rings surround the circular yellow areas, and later enlarge, coalesce, and become irregular. The fused rings become necrotic, usually after the leaf has turned yellow. Finally, the entire circular areas become necrotic and are still apparent on the dried leaves. Infection resulting from mechanical infection remained local, systemic infection not being obtained.

Common cucumber mosaic (not known to occur naturally on any host in California) produces on sugar beet leaves four to nine days after inoculation numerous white dots each with a pinpoint necrotic centre. These dots gradually enlarge, each retaining its pinpoint necrotic centre, until the white, circular areas fuse. Green rings, 3 to 8 mm. in diameter, surround pale, chlorotic areas, with a small, circular, central area and a necrotic centre. In the next two or three days these green rings become yellow, often coalesce, and finally become necrotic. The chlorotic areas enclosed by rings may turn brown and fall out. Yellow veinbanding appears along part of the midrib and lateral veins. Sometimes, forked chlorotic tissue spreads out from the rings. The infection obtained remained local.

SEVERIN (H. H. P.). **Additional virus diseases of Spinach in California.**—*Hilgardia*, 18, 15, pp. 553–558, 8 pl., 1948.

In addition to the five virus diseases of spinach already reported from California, namely, aster yellows [*R.A.M.*, 25, p. 242], sugar beet curly top [ibid., 8, p. 83], sugar beet mosaic [ibid., 27, p. 345], spinach yellow dwarf [loc. cit.], and [tomato] spotted wilt [ibid., 16, p. 502], two further viruses have been found occurring naturally on the crop, i.e., western cucumber mosaic and celery calico [see preceding abstracts].

Nine spinach varieties were inoculated with the two last-named viruses and five with sugar beet mosaic. The three viruses were recovered from naturally infected spinach and transmitted by mechanical inoculation to White Spin cucumber, Turkish tobacco, *Nicotiana glutinosa*, or sugar beet. The symptoms of the three

diseases on spinach are similar, vein-clearing, chlorotic spotting, blister-like elevations, and necrosis being common to all. Filamentous leaves, however, are produced only by western cucumber mosaic. The viruses can be differentiated by transference to sugar beets, on which the symptoms are more distinctive.

New Zealand spinach (*Tetragonia expansa*) was inoculated with western cucumber mosaic, and the virus was reisolated and transmitted to cucumber and sugar beet.

The green peach aphid (*Myzus persicae*) is the principal vector of the western cucumber mosaic, celery calico, and sugar beet mosaic viruses to spinach in the field, though the bean or dock aphid (*Aphis rumicis*) may occasionally be implicated in their transmission.

FELBER (IRMA M.) & HAMNER (C. L.). **Control of mildew on Bean plants by means of an antibiotic.**—*Bot. Gaz.*, 110, 2, pp. 324–325, 1948.

When an aqueous solution of actidione (an antibiotic isolated from beers in which strains of *Streptomyces griseus* are cultivated) was sprayed on to greenhouse-grown Red Kidney beans [*Phaseolus vulgaris*] severely attacked by *Erysiphe polygoni* [*R.A.M.*, 27, pp. 56, 248, 288], the patches of mildew on the upper surfaces of the leaves disappeared completely in 48 hours.

Further tests indicated that the most satisfactory results are given by a spray consisting of an aqueous dispersion of 0·25 per cent. methylcellulose (1500 cp. viscosity type) to which is added 5 p.p.m. of actidione. When the first application was made to the primary leaves of bean plants ten or 12 days old and the treatments were continued at intervals of six to ten days corresponding to the production rate of the trifoliate leaves, the plants were protected during their lifetime against infection even when surrounded by heavily infected controls. Actidione may, perhaps, prove to be active against other plant pathogens.

DUNDAS (B.). **Mutation in Bean rust uredospores in cold storage.**—Abs. in *Phytopathology*, 38, 11, p. 914, 1948.

Uredospores of a number of forms of bean rust [*Uromyces appendiculatus*: *R.A.M.*, 22, p. 88] produced on detached leaves during the summer of 1946 were subjected to varying temperatures before being placed in storage at 0° F. in the following autumn. On removal in July, 1947, very few of the spores were viable, some collections giving no infection and the rest only a few pustules [cf. ibid., 20, p. 556]. Isolations from the latter, tested on nine differential varieties, differed in every case from the form as stored, and in most instances from previously described forms. Numerous isolates from a mixture of uredospores of 15 pure forms yielded only eight forms, six of which were distinct from any hitherto reported. Since the unmixed uredospore collection of the other two forms yielded only mutants, it is considered likely that they may also have been mutants. Nine mutant forms have been isolated altogether. Mutation to the same form occurred in several different forms and two or more mutants were obtained from a single pure form. No consistent modification in virulence was observed.

KERNKAMP (M. F.). **Chemical treatment of Soybean seed in relation to nodulation by nodule bacteria.**—*Phytopathology*, 38, 12, pp. 955–959, 1948.

At the Minnesota Agricultural Experiment Station the application to soy-bean seeds of spergon with an inoculant of commercial nitragin did not influence nodulation by *Rhizobium leguminosarum* when the plantings were made in soil that already contained bacteria, and preliminary results from one field trial indicate that seed treatment with spergon, new improved ceresan, or semesan jr. had no effect on nodulation or yield. In steamed soil, however, spergon did reduce nodulation in comparison with the untreated control. The time of application of inoculant or fungicide does not appear to be of major importance in relation to nodulation, but

since the latter was slightly more abundant when nitragin was applied two days after seed treatment with spergon than simultaneously or two days before, it is advisable to follow the first-named practice.

GIDDINGS (N. J.). **Curly top of Muskmelon.** —*Phytopathology*, 38, 11, pp. 934–936, 2 figs., 1948.

Severin observed natural infection of muskmelon by the [beet] curly top virus in 1925 and 1928 [*R.A.M.*, 8, p. 83]. The disease has been destructive on the commercial crop in the west-central and southern portions of the San Joaquin Valley, California, in some seasons, and was also reported to be serious on early plantings of the Mildew Resistant 45 variety in the Salt River Valley of Arizona in 1947. The virus was recovered from diseased plants in the cotyledon and one- or two-leaf stage sent from this area in mid-April, and again from the stunted and distorted plants with runners 1 to 2 ft. long, received [at the Division of Sugar Plant Investigations] about the middle of June. Diseased cantaloupe plants in the same stage, collected on 21st May near Murray, California, also yielded the curly top virus. Persian melon plants in the same area carrying ripe fruits, though much dwarfed and distorted, were stated to show well-marked curly top symptoms.

The results of greenhouse inoculations with leafhoppers [? *Eutettix tenellus*] on muskmelon seedlings indicate that they are distinctly more resistant to curly top than sugar beets at a comparable stage. In comparative inoculation experiments with leafhoppers on plants in the young cotyledon stage of the muskmelon varieties Rocky Ford, Tip Top, Honey Rock, Hearts of Gold, Japanese melon, Honey Dew, Cranshaw, Golden Beauty Improved Casaba, Golden Hybrid Casaba, Persian, Hale's Best 45, and Mildew Resistant 45, using virus strains 1, 2, 3, 5, 6, 8, 9, and 10, besides some field selections of the pathogen, infection was obtained with all except strain 2. Strain 4, used on the Gem variety only, also gave negative results. The extent of the injury differed greatly according to the variety, Mildew Resistant 45, Hale's Best 45, and Honey Rock, being the most susceptible, while the Casabas and Cranshaw suffered least. A high percentage of the plants showing definite symptoms were severely dwarfed and many died. Some infected plants survived inoculation for over five months, and one dwarfed plant infected with strain 1 readily yielded the beet curly top virus at the end of this period. One plant infected with strain 10 made normal growth, but the virus was easily obtained from it four months after inoculation.

It is evident from these observations that the beet curly top virus may cause serious damage in commercial muskmelon plantings, and heavy losses were, in fact, reported both from California and Arizona during 1947. The possibility of selection and breeding for resistance to the disease is suggested by some of the greenhouse experimental results.

FIKRY (A.). **Effect of various brands of sulphur on the control of powdery mildew of Curcurbitaceae.**—*Bull. Minist. Agric. Egypt* 248, 33 pp., 1948.

From 1936 to 1939, the efficiency of various brands of sulphur, with and without inert fillers, in controlling cucurbit powdery mildew [*Erysiphe cichoracearum*: *R.A.M.*, 16, p. 364; 23, p. 284] in Egypt and their effect on yield were determined in several experiments with the susceptible Iskandarini vegetable marrow as the test plant. In each test treatments were made as soon as mildew appeared and two more at three-weekly intervals. In a preliminary test Sicilian and Gaza sulphurs, having a sulphur content of 99 and 94 per cent., respectively, controlled mildew completely, while plants treated with raw gypsum sulphur (22 per cent. sulphur) and Kattelsouse, a mixture of 16 per cent. sulphur and 84 per cent. rock phosphate, developed 9 and 26 per cent. mildew, respectively. All dusted plants were healthy after the second treatment while undusted plants were 100 per cent. infected.

Soufre gris (52 per cent. sulphur) and soufre noir (29·76 per cent.) also controlled the disease completely. It is concluded that a sulphur content of about 20 per cent. is required for efficient mildew control. Significant increases in yield were obtained with the different brands of sulphur employed, the increase over the untreated controls varying according to the brand of sulphur, its net sulphur content, and the date on which the experiment was carried out.

In the second series of tests Sicilian, Gaza, and gypsum sulphurs were mixed with inert fillers. In each test a mixture containing about 25 per cent. sulphur was sufficient for controlling mildew. Ground spent oxide (39·42 per cent. sulphur) proved as effective in control as the other sulphurs. Increased yields varying from 23 to 51 per cent. were obtained when these 25 per cent. sulphur mixtures were used.

In further experiments to determine the effect of known amounts (by weight) of sulphur and sulphur mixtures on disease control and yield, sulphur applied at 25 per cent. of the optimum dose (fullest holding capacity of the plant with dust) controlled mildew after three applications. A higher degree of control was obtained if, after the first application, the same reduced amount of sulphur was mixed with a filler at the rate of 1:3 for the subsequent treatments. Sulphur at 40 per cent. of the optimum dose gave the same degree of control as did the full amount. Increases in yield, however, were greater when the optimum sulphur dose was used than when reduced doses were employed.

YODER (J. B.). **The two-zone tray system in practice.**—*Bull. Mushroom Gr. Ass.* 13, pp. 182–183, 1948.

An account is given of the recently described two-zone tray system for the cultivation of mushrooms. Specially constructed houses are used for pasteurizing the compost and starting the spawn [zone one]. The trays are then transferred to an abandoned limestone mine, having a temperature of about 55° F. and a constant humidity above 95 per cent., on the Butler County Mushroom Farm, U.S.A. The two-zone tray method is especially suitable for places where diseases are aggravated by high humidity and where it is difficult to use the usual control methods.

RAUTAVAARA (T.). **Suomen Sienisato.** [The Finnish Mushroom crop.]—534 pp., 4 diags., 5 graphs, 4 maps, Helsinki, Werner Söderström Osakayhtiö, 1947. [English summary.]

This exhaustive, copiously documented and tabulated study on the fungi eaten in Finland was dictated by the economic stringency arising out of post-war food shortages and general impoverishment, which calls for an increased knowledge and utilization of the natural products of the country. There are more than 2,000 indigenous species of edible fungi, headed by the Agaricaceae (1,250), other groups represented being the Boletaceae, Polyporaceae, Hydnaceae, and Phylacteriaceae. Included in the treatise are sections on the mycofloristic composition of the crop; yield; possibilities of practical utilization of the mushroom crop; marketing and use of the Finnish crop; and value of the crop and its significance in the national economy. The bibliography comprises 23 pages.

HUNTE (W.). **Champignonbau in Haupt- and Nebenerwerb. Zweite neubearbeitete Auflage.** [Mushroom cultivation as a main and ancillary industry. Second revised edition.]—87 pp., 78 figs., 3 graphs, Berlin, Paul Parey, 1948.

Included in this useful, practical manual on mushroom [*Psalliota* spp.] cultivation is a section on the diseases affecting the crop in Germany, namely, brown plaster mould (*Myriococcum praecox*) [*R.A.M.*, 14, p. 345], verdigris (*Myceliophthora lutea*) [ibid., 26, p. 4; 27, p. 215], 'weed' fungi, rust and spot disease, soft rot (*Mycogone perniciosa*), and drop disease.

There are two forms of rust and spot disease. The first is, generally speaking, harmless and consists in the development on the surface of the caps of rusty-brown spots arising from the bacterial contamination of water drops. The identity of the bacteria is unknown, but they are probably introduced into the cultures with the casing soil. The second form of the disease is more dangerous. It resembles the foregoing in the appearance of the superficial spots, but on cutting the mushrooms a green-blue discoloration of the flesh is revealed, and at a certain stage they become malodorous and inedible. Defective aeration and excessive humidity are believed to be responsible for the trouble.

Drop disease has been very prevalent of late years. The affected mushrooms become coated with a liquid, viscous mass and are of a watery consistency within. Growth is arrested. The disease is extraordinarily infectious, entire blocks being involved with the utmost rapidity, and together with soft rot it calls for extreme vigilance. Infected mushrooms should be promptly removed from the beds and destroyed. Like other maladies, e.g., brown plaster mould and verdigris, drop disease originates in the manure, though it may also be carried on the spawn. Drop disease is stated to be very common in Hungary.

Fleury (C.). **Une maladie du Champignon de Couche (Psalliota campestris) non encore décrite en Suisse : la momification.** [A Mushroom (*Psalliota campestris*) disease not yet described in Switzerland: mummification.]—*Rev. hort. suisse*, 21, 10, pp. 279–282, 4 figs., 1 diag., 1948.

The mummy disease of mushrooms, described from the United States by Tucker and Routien [*R.A.M.*, 23, p. 54], is here reported for the first time from Switzerland, and possibly from Europe. It develops for the most part towards the close of the growing season and is characterized by typical malformations and secondary bacterial invasion. The spread of infection is easily arrested by the isolation of the diseased areas and a contiguous zone of 2 m. on each side, either by means of trenches 10 cm. in width or by two wooden planks the same distance apart, which should be regularly disinfected.

Husfeld (B.). **Gedanken zur Resistenzzüchtung.** [Reflections on breeding for resistance.]—*Züchter*, 15, 10–12, pp. 194–204, 7 figs., 1943.

In a lecture delivered at the International Viticultural Congress at Bad Kreuznach, Germany, in August, 1939, the author illustrated by concrete examples and references to the relevant literature, especially of vine diseases, his thesis that the future of plant breeding lies in the development of morphological and anatomical resistance to, and tolerance of, pathogenic organisms [cf. *R.A.M.*, 27, p. 218]. In this way a uniform barrier of resistance to all physiologic races will be set up, thereby excluding the new biotypes which tend to nullify the results achieved by selection on a narrower basis.

Arnaud (G.). **La valeur pratique des essais d'anticryptogamiques viticoles.** [The practical value of tests with fungicides for use on Vines.]—*Ann. Épiphyt.*, N.S. 12, *Sér. Path. vég., Mém.* 6, pp. 203–208, 1946.

This information has already been noted from another source [*R.A.M.*, 26, p. 43].

Baldacci (E.). **Epifitie di Plasmopara viticola (1941–46) nell' Oltrepò Pavese ed adozione del calendario di incubazione come strumento di lotta.** [Epidemics of *Plasmopara viticola* (1941–46) in the Pavia area of the Po valley and the adoption of an incubation calendar as a means of control.]—*Atti Ist. bot. Univ. Pavia*, Ser. 5, 8, 2, pp. 45–85, 2 graphs, 1947. [Received September, 1948.]

Studies of epidemics of *Plasmopara viticola* [*R.A.M.*, 28, p. 3], made from observatories set up in the Pavia area of the Po valley by the Pio Istituto Agricolo

Vogherese, have shown that primary infections do not occur unless the minimum atmospheric temperature is about 10° C., at least 10 mm. of rain have fallen in the previous 48 hours, and the vines have developed leaves measuring 6 to 8 sq. cm. (the corresponding shoot measurement being about 10 cm.). The germination of the oospores demands a soil temperature of 12° to 13° (occasionally 11°). The air temperature therefore gives only an approximate indication of the possibility of oospore germination.

When the percentage germination of the oospores is low and the rate slow, about three secondary invasions may occur, causing a serious epidemic and mass diffusion as in the case of 1946 epidemic. Generally a correlation exists between low rainfall for the winter–spring period and slight epidemics, although an abundance of rain during the same period does not appear to be sufficient to develop an epiphytotic unless another primary infection from oospores occurs at the same time.

It was found that in the area under consideration the pathogen required a shorter incubation period during May than that prescribed in Müller's disease calendar [ibid., 10, p. 432]. The importance of high atmospheric humidity in shortening the incubation period of *P. viticola* and the reverse were also observed.

Kunkel (L. O.). **Virus diseases of plants.**—*Circ. Bull. Mich. agric. Exp. Sta.* 208, pp. 3–19, 4 figs., 6 maps, 1947.

This address detailing some of the recent work on viruses was delivered at the Annual Fruit Growers' Conference, Michigan State College, January, 1947.

Kunkel (L. O.). **Variation in phytopathogenic viruses.**—*Ann. Rev. Microbiol.*, 1, pp. 85–100, 1947. [Received January, 1949.]

The recognition and study of plant virus variants has been promoted by three discoveries, viz., that the yellow and necrotic type strains of tobacco mosaic and cucumber mosaic viruses arise regularly in plants affected by the ordinary strains of these viruses [cf. *R.A.M.*, 6, p. 193; 9, p. 260; 13, p. 329; 14, p. 5], that closely related viruses have similar antigenic properties [cf. ibid., 8, p. 743; 13, p. 545; 14, p. 245], and that the immunity acquired by pre-inoculation with a strain of a virus seemed to be specific [cf. ibid., 11, p. 750; 13, p. 648]. The author surveys the present state of knowledge of virus mutants with particular reference to strains of tobacco mosaic, cucumber mosaic, potato latent mosaic or virus X, beet curly top, sugar-cane mosaic, and other reported strains of plant viruses. The paper concludes with a discussion of the available data and a list of 148 references.

Orton (C. R.). **The problem of quarantining plant viruses.**—*J. econ. Ent.*, 41, 3, pp. 477–486, 1948.

In this paper, presented before the Chicago Meeting of the American Association of Economic Entomologists on 28th December, 1947, some outstanding pertinent features of plant viruses are discussed and their vulnerable points brought into focus in relation to the quarantine problem [*R.A.M.*, 25, p. 320] under the following headings: the economic importance of virus diseases of plants (of which about 200 are now recognized throughout the world); physical characteristics of virus diseases; the basis for a programme of effective protection against virus plant diseases; and therapeutic treatment and detection of plants infected with viruses.

Plant diseases. Notes contributed by the Biological Branch.—*Agric. Gaz. N.S.W.*, 59, 12, pp. 633–635, 2 figs., 1 diag., 1948.

A brief, popular summary of the reasons for soil sterilization in New South Wales [*R.A.M.*, 27, p. 275] is given, together with a brief account of the symptoms and control of tomato leaf mould [*Cladosporium fulvum*: ibid., 24, p. 6]. Following cloudy, humid autumn weather this disease often causes heavy and damaging

infections in field crops when these are grown in the vicinity of greenhouses in the Warriewood–Mona Vale district.

GARNETT (C. B.). **Report of the Director of Agriculture.**—*Rep. Dep. Agric. Nyasald*, 1947, 18 pp., 1948.

It is stated in this report [cf. *R.A.M.*, 20, p. 113] that mosaic and brown streak of cassava [ibid., 26, p. 281] occurred in all areas of Nyasaland. Groundnut rosette [ibid., 26, p. 236] caused appreciable yield reductions only in late and widely spaced crops. Loose and covered smuts of sorghum [*Sphacelotheca cruenta* and *S. sorghi*: ibid., 27, p. 468] were widely distributed.

In March, 1947, tung nursery trees (mostly *Aleurites montana*) showed widespread symptoms of zinc deficiency [ibid., 25, p. 16], resulting in serious stunting and die-back of many plants; isolated field plants were also affected. Applications of zinc sulphate either as a spray or to the soil readily cured the condition.

Annual Report on the Agricultural Department, Nigeria, 1946.—55 pp., 1948.

The following items of phytopathological interest occur in this report. J. L. B. KINCAID, representing the Deputy Director, Western Provinces, states that most of the farmers' cassava, both east and west of the Niger, is severely infected by the mosaic virus [*R.A.M.*, 28, p. 115], which in its acute form causes heavy crop reductions. Breeding for resistance to the disease is in progress, and notes made on its incidence in a yield trial of eight hybrids and one favourite local variety at Ibadan demonstrated an unexpectedly low rate of spread in comparison with the high incidence in native plantings. In the local susceptible varieties, the first count three months after planting showed 42 per cent. infection, presumably contracted from diseased planting material. Three months later, at the end of the rainy season when the symptoms are most conspicuous, there was still only 44 per cent. infection. The corresponding figures for one of the hybrids were 6 and 7·9 per cent. infection, respectively.

Swollen shoot disease of cacao [ibid., 27, p. 515; 28, p. 115] is still confined to Oyo Province, where the principal foci of infection are in the Ibadan and Oyo Divisions. An isolated outbreak was recently observed in the vicinity of Ilesha, 60 miles from the nearest known centre of infection. The destruction of diseased trees remains the only known method of control. The total number cut to the end of December, 1946, was 17,651, covering some 44 acres.

Rapport annuel pour l'exercice 1947. [Annual report for the year 1947.]—*Publ. Inst. nat. Étude agron. Congo belge 1948* (hors sér.), 217 pp., 1948.

The following items occur in the sections of this report (pp. 38–51) dealing with phytopathological work in the Belgian Congo [cf. *R.A.M.*, 27, p. 463]. *Ascochyta pisi* was observed, for the first time in the country, on cowpea and guar [*Cyamopsis psoraloides*]. *Armillaria mellea* [ibid., 28, p. 31] was found on *Hydnocarpus anthelmintica*, a new host for the Congo.

Hevea rubber diseases included mouldy rot (*Ceratostomella fimbriata*); malformations caused by woody nodules in the cicatrization tissues of the tapping panels, probably akin to brown bast; and the root rots due to *Rigidoporus microporus* [*Fomes lignosus*: ibid., 28, p. 240] and *A. mellea*. Data relating to the influence of soil aeration on the mycelial growth of *F. lignosus* are tabulated. In coarse, medium, and fine gravel the distances traversed by the mycelium in 22 days were 11·95, 9·45, and 8·35 cm., respectively.

Mandarins suffered from foliocellosis [ibid., 27, p. 234] and were infected by *Septobasidium pseudopedicellatum* [ibid., 25, p. 234]; citrus canker (*Phytomonas* [*Xanthomonas*] *citri*), scab (*Elsinoe fawcetti*), and anthracnose (*Gloeosporium*

limetticola) occurred on lemons, and gummosis (*Diplodia natalensis* and *Phomopsis* sp.) on the same host and oranges. Another citrus disease observed during the period under review was concentric ring blotch [ibid., 14, p. 679].

Rice was attacked by *Helminthosporium oryzae* [*Ophiobolus miyabeanus*] and *Ustilaginoidea virens*.

Legumes, especially kidney beans [*Phaseolus vulgaris*], sustained injury from damping-off (*Rhizoctonia* [*Corticium*] *solani*) and anthracnose (*Colletotrichum lindemuthianum*). The former pathogen and *Alternaria solani* also attacked potatoes, and *Septoria lycopersici* was found on tomatoes.

Coffee, tea, and cacao were all damaged by root rots, caused predominantly in the first by *F. lignosus* (on *Coffea excelsa*) and in the other two by *Armillaria mellea*.

The chief pathogens of oil palm, viz., *A. mellea*, *Fusarium oxysporum*, the agent of patch yellow [ibid., 26, p. 103], *F.* sp. [probably *F. oxysporum*] responsible for wilt disease [ibid., 27, p. 523], *Ganoderma* sp., *Thielaviopsis basicola*, and *Fomes lignosus*, were isolated and maintained in pure culture. The first symptoms of infection by *A. mellea* are a wet rot and premature defoliation of the leafy stumps at the base of the trunk. The course of the disease may be either progressive, manifested by an increasingly severe foliar wilt, or sudden, destroying the palm by means of a generalized and immediate decay of all the internal tissues of the base of the trunk. The fungus is no longer found in plantations upwards of ten years old. It is much more prevalent and destructive in plantings laid down after clearance of the ground by burning than in those established in areas of natural reproduction.

The rot caused by *G.* (?) *pseudoferreum* is largely confined to 25- to 30-year-old palms in Elisabetha and Barumbu, and its depredations are of no great economic importance.

Two cases of 'plant failure' (Wardlaw's term for all pathological conditions which are not typically parasitic) in oil palms were investigated in Barumbu, namely, chlorosis in two- to four-year-old plantings and browning of the phloem. The former was found to be due to the more or less complete asphyxiation of the root system incidental to the method of planting in individual terraces on uneven ground, while the latter appears to be a normal accompaniment of senility, probably accelerated by repeated disturbances of the water balance. 'Little leaf disease' does not seem to threaten the cultivation of the oil palm in the north of the colony, though the causal organism, *T. basicola*, is almost ubiquitous.

A species of *Cladosporium* was frequently isolated from peach leaves affected by shot hole, while rust (*Puccinia pruni-spinosae*) is largely responsible for premature defoliation in orchards.

Apples are attacked by scab (*Fusicladium dendriticum*) [*Venturia inaequalis*], *Gloeodes pomigena*, and *Glomerella cingulata*.

Widespread mortality among *Cupressus* sp. is attributed to *Pestalotia funerea* at Keyberg and Elisabethville and to *D.* (?) *pinea* in the Kolwezi region. Numerous pines displayed a very marked rolling of the needles, related in the early stages to leaf curl and in the final phase to needle fusion [ibid., 20, p. 340; 22, p. 231; 25, p. 373, *et passim*].

Maize was infected by dry rot (*D. zeae*).

Tobacco diseases included wildfire (*Bacterium* [*Pseudomonas*] *tabacum*), tobacco mosaic virus, rosette [frenching], and the leaf spots due to *Alternaria longipes* and *Cercospora nicotianae*.

BURKHOLDER (W. H.). **Bacteria as plant pathogens.**—*Ann. Rev. Microbiol.*, 2, pp. 389–412, 1948.

After a brief introduction dealing with early researches into the bacterial origin of certain plant diseases, the author discusses from a critical standpoint and with 110 references to the relevant literature the classification of bacteria [cf. *R.A.M.*,

28, p. 56] and the relationships that exist between parasitic bacteria and their host plants.

Rather fewer than half the phytopathogenic species are classified in the genus *Pseudomonas* [cf. ibid., 17, p. 303]. The second largest group, consisting of one fourth of all the plant-pathogenic species is *Xanthomonas* [cf. ibid., 18, p. 659], which contains only plant pathogens; the species are acid-tolerant. *Agrobacterium* [ibid., 22, p. 344] includes the soil bacterium *A. radiobacter*. The genus is related to *Rhizobium* [cf. ibid., 19, p. 461; 22, p. 127], but its members do not fix nitrogen. The nine Gram-positive species of phytopathogenic bacteria so far described have been placed in *Corynebacterium* [cf. ibid., 21, p. 364; 27, p. 66] though two species are motile, a character not present in the type species, *C. diphtheriae*. The limiting characters of *Erwinia* [ibid., 27, p. 513] are plant pathogenicity and motility with peritrichous flagella. Though based on somewhat superficial characters, the genus presents a certain unity. The species have often been divided into two groups, viz., those producing blight and those producing soft rot. The latter generally produce acid and sometimes gas from lactose, and show relationships to members of the family Enterobacteriaceae.

The differentiation of species is effected by the determination of their morphology, cultural characters, and biochemical reactions. Pathogenicity has also been used, being in some instances the sole separating character. *X. juglandis* and *X. corylina*, for example, are morphologically, culturally, and biochemically alike, but distinct pathogenetically. Pathogenicity as a specific character must be taken into account in plant pathology because it clarifies many disease relationships.

Certain disease bacteria infecting seed have been eliminated by heat and chemicals. Hot water treatment of cabbage and cauliflower seed (122° F.) eliminates *X. campestris* [ibid., 27, p. 343], tons of seed being treated every year in the United States, where this disease has been reduced from major importance to a point where it occurs only in a few scattered fields.

Tervet (I. W.) & Hollis (J. P.). **Bacteria in the storage organs of healthy plants.**—*Phytopathology*, 38, 12, pp. 960–967, 1 fig., 1948.

Evidence is adduced, from isolation studies on over 1,000 submerged tissue plug cultures at the Nebraska Agricultural Experiment Station, pointing to the presence of a mixed bacterial flora in healthy storage organs of potato, red beet, turnip, carrot, and kohlrabi [cf. *R.A.M.*, 27, p. 293].

Two morphological types of bacteria, namely, a clostridial form and a Gram-negative rod, were shown to be responsible for breakdown of potato, carrot, and lucerne tissue, with liberation of cell contents, principally raw starch. They were separated by half-an-hour's immersion of tubes containing the tissue plugs in water heated to 80° C. (which the clostridial form survived) and on dilution plates (which would not support the growth of the clostridial form), and were grown in pure culture on potato dextrose agar. The evidence indicated that a complex of two or three organisms might be responsible for the tissue breakdown in submerged culture. Blackening of potato plugs occurred in individual tuber units.

Cowan (S. T.) & Shaw (Constance). **Outline classification of Bacterium and Staphylococcus.**—*J. gen. Microbiol.*, 3, 1, pp. 69–73, 2 diags., 1949.

In the list of species maintained in the National Collection of Type Cultures [*R.A.M.*, 28, p. 73], unorthodox classifications of the genera *Bacterium* and *Staphylococcus* are used. For convenience in cataloguing, *Bacterium* is divided into groups representing coliforms, plant pathogens, non-fermenting species, and paracolons, some of which may eventually be accorded generic rank. To this list is added a miscellaneous group of organisms of uncertain taxonomic position. The plant pathogens are listed as a separate group for ease of reference although

it is agreed that they should be regarded as members of the main *coli-aerogenes* group with *Bact. coli* as the type species.

Bisset (K. A.). **Observations upon the cytology of corynebacteria and mycobacteria.** —*J. gen. Microbiol.*, 3, 1, pp. 93–96, 1 pl., 2 figs., 1949.

Cytological investigations conducted in the Bacteriological Department, Birmingham University, showed that in young cultures of *Corynebacterium diphtheriae* and *Mycobacterium* spp. the bacilli are multicellular, the individual cells being almost spherical, a single bacillus containing one to twelve or more units. Reproduction may take place either by division of the cells, followed by simple fission of the organism, or by fragmentation into single cells which subdivide without separating and grow into multicellular bacilli again. These genera do not appear to possess any morphological characters in common with *Actinomyces* with which they are classified at present.

Proom (H.) & Hemmons (Lois M.). **The drying and preservation of bacterial cultures.**—*J. gen. Microbiol.*, 3, 1, pp. 7–18, 1949.

Details are given of freeze-drying methods to which some 1,500 strains of bacteria were subjected at the Wellcome Research Laboratories, Beckenham, and the results of viability tests after storage, by counts using a spinning bottle modification of the roll-tube technique [*R.A.M.*, 27, p. 489]. The percentage survival varied from 100 per cent. to less than 1 per cent. when the organisms were suspended in broth and from 100 per cent. to no survivors when they were suspended in saline. Longevity of dried cultures in storage was dependent on the storage temperature, thorough drying, and the absence of oxygen. Suitably dried cultures remained viable at room temperature for very long periods. A simple method of determining the capacity of a dried culture to remain viable in storage at ordinary temperatures is to ascertain the survival rate of bacteria in a sample after heating to 80° for 1 hr. and plating a suspension of it in broth.

Lacey (Margaret S.). **Studies on Bacterium fascians.—V. Further observations on the pathological and physiological reactions of Bact. fascians.**—*Ann. appl. Biol.*, 35, 4, pp. 572–581, 3 figs., 2 graphs, 1948.

Further experiments with *Bacterium* [*Corynebacterium*] *fascians* [*R.A.M.*, 21, p. 282] showed that sweet pea seeds inoculated with the organism had a considerably higher germination rate than the sterile controls. Subsequently the infected seedlings grew normally for about 10 to 15 days, after which the increase in length of the primary shoot almost or entirely ceased and hypertrophied basal shoots from normally dormant buds usually developed; occasionally, however, stunting was the only symptom. Sometimes the apical bud showed distinct fasciation and axillary galls were produced. In a few cases shoots with abnormally long thin internodes and rudimentary leaves developed. Seeds treated with bacteria-free culture extracts gave similar results with, in one experiment, 44 per cent. germination, but treatment with culture extracts of *Bact. tumefaciens* caused depression of the germination rate (4 per cent.) and of early plumule growth. Seeds infected with *Pseudomonas fluorescens* (a frequent contaminant on isolation plates) made good growth; with *C. fascians* in addition germination was markedly delayed, plumule growth was weak or absent, and the seedlings became more severely infected than those inoculated with *C. fascians* alone, a wart-like growth of the undifferentiated tissues often being the only development. Impure cultures of *C. fascians* taken from the first isolation plates from plant galls were frequently much more virulent than the final pure cultures.

Bean seedlings (*Phaseolus vulgaris*) inoculated with *Bact. tumefaciens* produced characteristic galls at the site of injury only, those inoculated with *C. fascians*

continued growth for a time but the internodes were short and swollen, with stunting similar to that of infected sweet-pea seedlings. Sometimes growth ceased after two or three internodes had been formed, and a gall-like growth developed from the apical and axillary meristems. When apical buds were treated with culture extracts of *C. fascians* the new growth was stunted but cut surfaces produced no galls, whereas injured surfaces treated with *Bact. tumefaciens* extracts developed them.

Lettuce seedlings grown in bacteria-free culture filtrates of *Bact. tumefaciens*, *P. fluorescens*, *Bact. carotovorus* [*Erwinia carotovora*], and *Bact.* [*Aerobacter*] *aerogenes*, after marked delay in germination, developed very short, swollen 'peg-top'-shaped roots (maximum length 0·5 cm.), covered with abnormally abundant root hairs. A distinct ring of swollen tissue usually developed in the hypocotyl section. Roots of seedlings grown in *C. fascians* extracts, though shorter, developed normally; seed germination and early growth were usually slightly delayed. The growth lag was much greater in seeds treated with uninoculated lettuce medium (macerated, sterilized, etiolated lettuce seedlings). Later development of the shoot was normal in all cases. Culture extracts of *C. fascians* contained no auxin, uninoculated lettuce-extract media had some, while the extracts of the other bacteria had the highest auxin content.

Lettuce seedlings grown in 1/1,000,000 to 1/5,000,000 solutions of β-indole acetic acid developed root symptoms identical with those caused by filtrates of *Bact. tumefaciens*, while higher concentrations produced still more marked hypertrophy. The roots grown in a 1/10,000,000 dilution were similar to those grown in the uninoculated medium, while those in 1/100,000,000 dilution resembled those treated with *C. fascians*. When β-indole acetic acid was added to a peptone-broth medium before adding the bacteria, three days after inoculation the culture fluids of four strains of *C. fascians* (12, 405, 421, and 448) gave completely negative auxin tests. Other strains exhibited varying powers of destruction of the growth-promoting substance, a few being quite inactive. On the other hand all the other bacterial species tested caused a definite increase in the concentration of β-indole acetic acid in the same period. The same four strains of *C. fascians* also destroyed or inhibited the auxin present in the lettuce medium; all the other bacterial species not only increased it, but also produced growth-promoting substances in those plant extract fluids previously without them. Other experiments showed that *C. fascians* can also destroy growth-promoting substances produced by other bacterial species.

No difference in pathogenicity to sweet pea seedlings was observed between 'rough' or 'smooth' colonies or between auxin active or inactive strains. Further tests showed that while the original culture of an inactive strain of *C. fascians* continued to be completely inactive, four reisolates of this strain from sweet pea were very active and remained so.

In contrast to the gall formation and lateral bud inhibition caused by *Bact. tumefaciens* [ibid., **28**, p. 16], *C. fascians* when virulent stimulates the growth of [sweet pea] lateral buds to such an extent that 'leafy galls' are produced and growth of the primary shoot is stopped. This effect may be due to the loss or disturbance of the normal auxin content.

De Ropp (R. S.). **The movement of crown-gall bacteria in isolated stem fragments of Sunflower.**—*Phytopathology*, **38**, 12, pp. 993–998, 1948.

In experiments at the New York Botanical Garden to determine the rate of movement of crown gall (*Phytomonas* [*Bacterium*] *tumefaciens*) bacteria through isolated sunflower stem fragments [cf. *R.A.M.*, **26**, p. 289 *et passim*] 9 mm. long placed upright in nutrient agar cultures, a loopful of suspension containing 10 to 100 organisms was applied to the upper cut surfaces. The bacteria traversed the stem

fragment and appeared on the agar within four minutes from the time of application, their velocity of movement being independent of the polarity of the fragments. After three days' culture, callus formation on the cut surfaces prevented the migration of the bacteria through the stem, both the upper and lower calluses being equally effectual in this respect. Bacteria applied to the lateral surfaces of stem fragments placed on their sides on the agar produced tumours at the ends of the fragments. Starting at the top or base of intact sunflower internodes, the bacteria travelled about 5 cm. through the stem in the course of one hour, no significant difference being observed between the upward and downward movements as regards rate and distance. It would appear from the results of these studies that the movement of *Bact. tumefaciens* in isolated sunflower stem fragments takes place through the tracheae, the motive force being supplied by the organisms themselves.

Evans (Sir G.). **Cocoa disease in the Gold Coast.**—*Nature, Lond.*, 163, 4138, pp. 271–272, 1949.

The author reviews and discusses the findings and recommendations of the report of the Commission of Enquiry into the swollen shoot disease of cacao in the Gold Coast [*R.A.M.*, 28, p. 163]. The industry is not likely to recuperate unless the growers can be induced to treat their cacao as an orchard crop with the new plantations on modern lines as compact groups in areas which have been completely cleared and left fallow for two or three years. The best hope for the future lies in further research along the lines indicated in the report and the resolve to re-establish the industry on rational lines. Meantime, the crisis may be alleviated by pressing on with the 'cutting-out' campaign.

Darlington (C. D.). **Threat of disease in tropical crops.**—*Nature, Lond.*, 163, 4139, p. 332, 1949.

Referring to the report of the Commission of Enquiry into cacao swollen shoot in the Gold Coast [see preceding abstract], the author draws attention to the statement made therein that drought, old age, lack of canopy, and poor soils have nothing to do with the disease, and points out that this view does not appear to be based on any experimental evidence. On the other hand, the committee recognizes the importance of the genetic variable, since it agrees that the development of resistant varieties would be an ideal solution. This fundamental principle is, however, omitted from the conclusions of the report and its application is postponed by the statement that it takes many years to obtain seed from a single crossing of two parents, though it takes only two years, and even this period could be reduced by experimental improvement of growing conditions. In cacao-growing, this fundamental solution is being treated as a matter of no urgency without any plan for attempting it.

Report of Cocoa Conference held at Grosvenor House, London, 14th–16th September, 1948.—ix+97 pp., 5 pl., 4 maps (2 col.), 7 col. charts, London, The Cocoa Chocolate and Confectionery Alliance, Ltd. [1948].

At the Cocoa Conference held in London in September, 1948 [cf. *R.A.M.*, 26, p. 190], L. J. Schwarz (Association of Cocoa and Chocolate Manufacturers of the United States of America) speaking on cacao in the Western Hemisphere stated that the American Cacao Research Institute was organized towards the end of the war. Its chief aims are to stimulate interest in cacao planting and to promote better husbandry in existing plantations. The scene of operations selected lies mainly in the American Republics of the Western Hemisphere, but a project is also being launched in Liberia, where planting with home-grown seeds is already in progress and 1,000,000 cacao trees under one year old are growing. The Atkins

Garden and Research Laboratory, Cuba, has agreed to co-operate with the Institute in forming and maintaining a cacao reference collection for the use of scientists generally and setting up a quarantine station. In Ecuador, promising selections are being multiplied vegetatively and subjected to extensive disease resistance trials, and it is hoped that disease-resistant planting stock will be released to growers in Ecuador in the near future. In the discussion that followed, A. Balleyguier (France) stated that in Cayenne Island 25 ha. of old cacao fields are still in existence, with an average yield of 10 to 12 tons of excellent beans free from all disease. J. West viewed with concern the possibility that cacao diseases may be introduced into West Africa with planting material from the Western Hemisphere.

Sir G. Evans (Royal Botanic Gardens, Kew) dealing with cacao prospects in British Guiana and British Honduras described an abandoned cacao planting near Marudi, in the former colony. Although perhaps two hundred years old there was no sign of virus disease and very little damage to the pods from either witches' broom (*Marasmius perniciosus*) [ibid., 26, p. 383] or black pod [*Phytophthora palmivora*: ibid., 27, p. 226]. There were a few witches' brooms of a peculiar kind, unlike those caused by *M. perniciosus*. There was no proliferation, but the end of the affected twig thickened out into one long shoot, often over two feet long and over 1 in. in diameter. The form of the disease observed in this planting did not appear to be virulent and should prove easy to control.

J. West (West African Cacao Research Institute) reported that black pod disease is a major problem in British Cameroons. Cacao should not be grown at elevations of 2,000 feet or over, or in places where mists predominate during the rains. The existing wide spacing is injurious, as trees so planted are low-branched and retain high humidity within the leaf canopy; close planting gives tall trunks with a leaf canopy high up, the trees bearing most of the pods on the trunks in conditions where the air can circulate and humidity should be less. The present system of drastic pruning, unnecessary with more closely planted trees, leads to abundant chupon growths which help to retain moisture round the pods on the trunks. Much more attention should be paid to the removal of dead pods and of the young green pods which bear the brown lesions of the fungus in its most actively sporulating phase. In the ensuing discussion A. V. Gibberd (Nigerian Cocoa Survey) stated that in the Western Province of Nigeria the regular removal of diseased pods as soon as they are seen (a practice started by West locally) has proved by far the most effective method of control of black pod. Local growers are now adopting this procedure. There is, however, a large gap in our knowledge of the existence of black pod disease under the widely varying conditions of soil, climate, and altitude in which cacao grows in Nigeria, and this simple method may not be effective in all areas and seasons. Last year, for example, disastrous outbreaks resulted from the phenomenal rainfall in the short dry season, when cacao was coming to maturity. Spraying and dusting as alternative methods are now under study. In reply to an inquiry, Gibberd added that as far as is known there is no swollen shoot [see preceding abstracts] in the Cameroons, though a suspected virus disease is being investigated there. The advantage of the native method of cultivation over the plantation method is that it affords considerable protection against the spread of swollen shoot. Where there are small plants separated by bush or arable land it is much more difficult for the disease to spread. W. F. Feaver (Cadbury Bros., Ltd.) reported that in the Ivory Coast [ibid., 27, p. 557] the policy of general cutting out has been changed to one of cutting out to isolate, leaving cacao within the red [swollen shoot infected] area to produce, presumably, a diminishing crop. Replanting is taking place in localities remote from the isolated areas. To this, Balleyguier added that Ivory Coast farmers have now taken to coffee- rather than cacao-growing.

D. H. Urquhart (Gold Coast) stated that swollen shoot is a major, immediate threat to the cacao crop, which is the only significant export. In the absence of

cacao exports the Gold Coast would be without a major cash crop or an important industry. He expressed confidence that the disease will in time be brought under control and that cacao will continue to be grown successfully and profitably.

W. H. Beeton (Gold Coast) reported on his activities, as Commissioner of the Swollen Shoot Campaign during the past six months, in the control of swollen shoot by cutting out and rehabilitation. Owing to political disturbances the plans described could not be put into effect. In the discussion that followed, E. E. Melville (Colonial Office) stated that it has now become obvious that in order to persuade about half a million farmers to adopt a policy of cutting out, which is clearly inconsistent with their immediate interests, it must be made worth their while to do so. The money available for compensation to growers is estimated at £3,000,000 to £9,000,000.

J. West reviewed research work done at the West African Cacao Research Institute since 1944. A. H. Strickland (West African Cacao Research Institute) summarized advances made during the last year in our knowledge of the behaviour and habits of the insect vectors of swollen shoot.

R. E. D. Baker (Imperial College of Tropical Agriculture) gave a brief account of the cacao virus disease situation in Trinidad [ibid., 28, p. 162].

M. Palma (Venezuela) stated that witches' broom [*M. perniciosus*] is the most serious cacao disease in Venezuela [ibid., 21, p. 324]. It was first reported near the Orinoco River in 1937 [ibid., 17, p. 288], but a survey made that year showed that it was also present in the Paria Peninsula and the 'canos' of the Paria Gulf. The intensity of the infection then found suggested that the disease had been present for some years. Appreciable damage is caused in the Orinoco Valley; many trees have been cut out and the land planted with other crops. In the Paria Peninsula fairly good crops are still obtained. The disease recently appeared in the Barlovento area, where though incidence was under 0·5 per cent. it was widespread. No artificial control has been attempted. Next in importance is watery pod rot, caused by *Monilia* [*roreri*: ibid., 21, p. 324; 24, p. 272], which occurs only in the west of Venezuela, where five types of cacao are grown. It is responsible for a high percentage of loss. The next most important pod disease is due to a species of *Phytophthora* [*P. palmivora*: ibid., 21, p. 324], but the extent of the damage does not appear to be great. Stem and root diseases are so far of minor importance.

A double-page coloured map shows the areas in the Gold Coast affected by swollen shoot and a coloured chart gives the spread of the disease there from 1936 to 1947, with tonnage marketed, price paid to the farmer, and total number of trees infected each year.

Bever (W. M.) & Slife (F. W.). **Effect of 2,4-D in culture medium on the growth of three pathogenic fungi.**—*Phytopathology*, 38, 12, pp. 1038, 1 fig., 1948.

In a preliminary study at the University of Illinois on the effect of 2,4-D on the growth of the cereal pathogens, *Gibberella zeae*, *Helminthosporium victoriae*, and *Pythium debaryanum* [cf. *R.A.M.*, 28, pp. 71, 228], the sodium salt (sodium dichlorophenoxyacetate monohydrate), butyl ester (butyl-ester 2,4-dichlorophenoxyacetate), and the amine (triethanol-amine-2,4-dichlorophenoxyacetate) were each prepared in dilutions of 250, 500, 1,000, and 2,000 p.p.m. of the active acid. Potato dextrose agar was liquefied by heating in an autoclave at 240° F. and then cooled to 77° before thoroughly mixing in the hormone; 20-c.c. aliquots were poured into 15 Petri dishes for each formulation and dilution.

P. debaryanum was killed by all dilutions of the sodium salt and the amine, while the butyl ester retarded growth in proportion to the dilution. *G. zeae* and *H. victoriae* did not succumb to any of the dilutions tested, but the development of both was materially delayed in proportion to the concentration of the growth substance.

Ekstrand (H.). **Skadorna på de övervintrande grödorna vintern 1947–48.** [Damage to the overwintering crops in the winter of 1947–48.]—*Växtskyddsnotiser, Växtskyddsanst., Stockh., 1948*, 5, pp. 70–75, 1 fig., 1948.

During the winter of 1947–8 *Sclerotinia trifoliorum* caused exceptionally little damage to the clover crops in most parts of Sweden [*R.A.M.*, 28, p. 164]. On the other hand, *Typhula borealis* was responsible for heavy losses of clover, lucerne, autumn cereals, and forage grasses, and its ravages would have been even more noticeable but for the concurrent attacks of snow mould (*Fusarium*) [*Calonectria nivalis*] on rye and wheat. Antagonism between these two species has been demonstrated in the laboratory and observed in connexion with sowing time and varietal reaction tests. For instance, in an experiment at Apukka, Finland, stands of Greus rye sown on 4th August showed a predominance of snow mould and only slight infection by *T. borealis*, in the sowings of 9th and 16th August the position was reversed, while for those of the 23rd and 30th the incidence of snow mould was rated as slight and unimportant, respectively, and that of *T. borealis* as high and predominant, respectively. The influence of crop rotation on snow mould was clearly shown in a rye field visited in East Gothland, where the infection was much more severe in the portion following rye than in that immediately after lucerne. Other instances of soil infection by *C. nivalis* were observed in West Norrland, where rye was badly diseased following the same crop but scarcely damaged where clover preceded it in the rotation.

Jamalainen (E. A.). **Report on the tests of seed treatment in the Agricultural Experiment Station, Department of Plant Pathology, in 1947.**—Reprinted from *Koetoiminta ja Käytäntö*, 3 pp., 20th April, 1948. [Finnish, with mimeographed English summary.]

Wheat bunt (*Tilletia caries*) was effectively combated in experiments carried out in 1947 with the mercurial fungicides akmosan 117 (Finnish), aagrano [*R.A.M.*, 28, p. 10] (both at 2 gm. per kg.), new improved ceresan and certosan [loc. cit.] at 1 gm., lunasan and semenon [ibid., 26, p. 336] (2 gm.), and täyssato 107b (1·5 gm.), all of which reduced the percentage of infection from 25·3 to 0. Reasonably good control of this disease was also secured by seed treatment with the non-mercurial preparations nomersan [ibid., 20, p. 535 *et passim*], phygon, spergon, and TMT (tetramethyl thiuramdisulphide) (all at 1·5 gm.). They were, however, ineffectual against loose smut of oats (*Ustilago avenae*) and barley blight (*Helminthosporium gramineum*).

Oat seed-grain was heavily contaminated (66·4 per cent.) by *U. avenae*. Infection was completely eliminated from the plots treated with akmosan 117 (3 gm.) and ceresan (1 gm.), while aagrano (3 gm.) was almost equally efficacious (0·9 per cent.). The percentages for certosan, lunasan, semenon, and täyssato 107b (all at 3 gm.) were 6·3, 3·4, 6·7, and 8, respectively.

Absolute control of *H. gramineum* was obtained by treatment of the barley seed, which was 8·9 per cent. contaminated, with aagrano, agrosan GN, akmosan 117, certosan, lunasan, and semenon (all at 2 gm.), ceresan (1 gm.), and täyssato 107b (1·5 gm.).

Rosella (E.). **Pour combattre la carie du Blé.** [To control Wheat bunt.]—*Progr. agric. vitic.*, 131, 10–11, pp. 144–145, 1949.

As French farmers sometimes apply wet treatments against wheat bunt [*Tilletia caries* and *T. foetida*: *R.A.M.*, 27, p. 358 and preceding abstract] by merely sprinkling the seed with a disinfectant the author considers that better results would be given by dusting it with powders containing copper, mercury, trioxymethylene [cf. ibid., 27, pp. 517, 541], or hexachlorobenzene [ibid., 26, pp. 150, 294] at the rate of 200 to 250 gm. dust [per 100 kg. seed.]

Varieties of Wheat recommended for 1949 sowing, with recommendations for temporary pasture mixtures.—*Agric. Gaz. N.S.W.*, 60, 1, pp. 3–8, 1 map, 1949.

The varieties of wheat recommended for sowing in 1949 in the different wheat belts of New South Wales are listed together with notes on their qualities and reaction to diseases. Pusa 4, Fedweb 1 (susceptible to leaf [brown] rust [*Puccinia triticina*]), Bungulla, and Ghurka are no longer recommended and Waratah is recommended for one zone only. The rust [*Puccinia* spp.]-resistant Gabo [*R.A.M.*, 26, p. 98] is likely to replace Bungulla and Gular, while Quadrat is recommended in preference to Ghurka for early sowing in some parts of the Riverina.

McKinney (H. H.). **Wheats immune from soil-borne mosaic viruses in the field, susceptible when inoculated manually.**—*Phytopathology*, 38, 12, pp. 1003–1013, 1948.

Observations on the Harvest Queen wheat selection and the so-called mosaic-resistant wheats revealed discrepancies between the field behaviour of these plants and their reactions to manual inoculation with the wheat mosaic virus (including mosaic rosette) [*R.A.M.*, 5, p. 85; 24, p. 136, *et passim*]. Experiments were accordingly carried out at the Plant Industry Station, Beltsville, Maryland, on some wheat lines selected for high mosaic resistance or immunity from the disease in fields with a high level of soil infestation. All the seedlings were grown in steamed soil in 6-in. pots in a cool greenhouse during the winter or in a special culture chamber, receiving light for eight hours daily in the summer months, the temperature being adjusted to between 66° and 65° F. The inoculations were performed when the seedlings had reached the three-leaf stage, the leaves, roots, or underground leaf sheaths being drawn between the thumb and fingers moistened with fivefold diluted infective juice from fresh diseased leaves with the addition of 600-grain carborundum powder.

The several isolates of the mosaic rosette virus were indistinguishable, but those of yellow mosaic induced consistently different symptoms in the susceptible Michigan Amber wheat. All caused the formation of yellow-green to yellow markings on the foliage and stunting of the plants, but the isolates from La Porte, Indiana, and from Granite City, Illinois, were less virulent than the others. The isolate from La Fayette, Indiana, is responsible for extreme rolling and distortion of the leaves in their early stages of development, while that from Clemson, South Carolina, causes severe stunting of the plants, most of which die prematurely, and extensive destruction of the plastid pigments. The field-resistant or immune wheats were just as heavily infected (more so in one test) by artificial methods as the susceptible Michigan Amber controls. Taking the totals from all the tests with a composite collection of the different viruses, 42·71 per cent. of the Michigan Amber and 33·85 per cent. of the field-immune seedlings developed mosaic after the first inoculation. The few isolations made from mild-mosaic plants occurring among the resistant lines in the field pointed to the implication of the mosaic rosette virus in this form of the disease. Some areas also appear to harbour non-rosetting green mosaic viruses, i.e., those that do not induce rosette in Harvest Queen selection.

Comparatively few barley varieties have been tested in mosaic-infested fields, but in general they tend to be more resistant than wheat, though Nakano Wase is highly susceptible. In the manual inoculation tests the percentages of infection obtained on the field-immune Purdue 21, Purdue 25 and 28 Hybrids, and Smooth Awn 86 were very low.

Atkinson (R. E.). **Western Wheat mosaic in Colorado and its transmission by Toxoptera gramineum.**—Abs. in *Phytopathology*, 39, 1, p. 2, 1949.

In 1947 an epidemic of wheat mosaic virus [see preceding abstract] occurred in

three districts of eastern Colorado, and in 1948, though generally less severe, it was responsible for substantial losses in two other regions. The implication of the virus was established by inoculating susceptible plants with filtered extracts of diseased material. In repeated experiments plants grown in soil from infected fields have shown no mosaic symptoms, and tests to determine whether it is seed-borne gave negative results. In the greenhouse the wheat mosaic virus was transmitted by the grain aphid, *Toxoptera gramineum*, viruliferous individuals of which were isolated and implanted in pots of ten healthy wheat plants. In every pot 30 to 50 per cent. of the plants developed mosaic symptoms, which non-viruliferous aphids did not induce. Plants suffering from dry-land foot rot were also observed to show mosaic symptoms, and extracts from them uniformly produced the latter disease in healthy plants, suggesting a relationship between the two disorders in early wheat in Colorado.

Moore (W. C.). **Take-all of cereals in England and the epidemic of 1948.**—*J. Minist. Agric.*, 55, 9, pp. 383–385, 1948.

The 1948 outbreak of take-all of wheat and barley [*Ophiobolus graminis*] in England [*R.A.M.*, 27, p. 278; 28, p. 168, and next abstract] was the most severe and widespread since the disease was first recognized some 35 years ago. Three of the six years 1943–8 were take-all years resulting from the more continuous cropping during the war, but the severity of the 1948 epidemic was due primarily to an unusual combination of circumstances. The wet summer of 1946 was followed by a severe winter, so that stubbles were not ploughed under until late in the spring of 1947, or if they were, they remained frozen and unrotted. The following summer was hot and dry and in many districts the stubble was still unrotted and the fungus active in the residues when favourable conditions led to early autumn sowings. Thus the one year break in cereal cropping had practically no effect and the disease occurred in 1948 on land where no wheat or barley had been grown the previous year. Fungus development was further favoured by the mild winter and exceptionally heavy rains in January, 1948, which retarded root growth. The growth of the fungus was checked by the dry early spring, but with the onset of wet conditions it renewed its activity and the 'white heads' stage was prevalent in most parts of the country well before harvest, when black mould [*Cladosporium herbarum* and *Alternaria* spp.: ibid., 23, p. 11] also appeared on the diseased ears. If the crop is otherwise healthy, however, black mould has no adverse effect on the ripening or germination of the grain.

A recurrence of the epidemic in 1949 is not expected, especially if precautions are taken with regard to adequate rotation and grass weeds.

Ogilvie (L.) & Collett (F[lorence] W. M.). **The take-all disease of Wheat and Barley.**—*J. nat. agric. adv. Serv.*, 1, 2, pp. 98–100, 1948.

During 1948 wheat and barley fields in the south-west counties of England were severely affected by take-all (*Ophiobolus graminis*) [see preceding abstract]. The disease was apparent about the middle of April, and became increasingly evident in June and July, after a period of dry weather had checked the growth of the plants. Wet weather in mid-August caused blackening of the prematurely ripened ears. Damage was most severe on light calcareous soils.

It was clearly demonstrated that crops following wheat and barley (24 reported with take-all) or bare fallows after these cereals (22 take-all cases) greatly increased the incidence of the disease. An average of one wheat or barley crop every three years, on the other hand, resulted in a low incidence of take-all. It is suggested that in the south-west a three- or four-year ley is the best safeguard after a severely infected crop.

GOODALL (D. W.). **Studies in the diagnosis of mineral deficiency. V. Manganese deficiency in Wheat.**—*Ann. appl. Biol.*, 36, 1, pp. 26–39, 2 graphs, 1949.

At 14 sites in south-eastern England cultivated with winter wheat, 12 of which were known or suspected to have manganese deficiency [*R.A.M.*, 25, p. 98], a manganese sulphate spray was applied late in the shooting stage and the effect on yield estimated. Samples from unsprayed wheat plants collected on three occasions between tillering and ear emergence, and from weeds gathered at the same time and after harvest, were analysed spectrographically for manganese content.

The results demonstrated that plant analysis can be used to forecast the response of wheat to a manganese sulphate spray, the following tentative limiting values for manganese content above which no yield increase as a result of treatment may be expected being 34 p.p.m. manganese in the dry matter of the lower leaf blades during tillering and 36 p.p.m. in stems just prior to ear emergence. The highest correlation between response and manganese content was that obtained with the values for stem samples gathered just prior to ear emergence. The analysis of weed samples indicated only gross differences in the manganese status of various sites.

GOODALL (D. W.). **Studies in the diagnosis of mineral deficiency. IV. The mineral content of Barley plants in relation to potassium deficiency.**—*Ann. appl. Biol.*, 35, 4, pp. 605–623, 4 graphs, 1948.

In 1943, barley samples (older leaf blades and sheaths, young leaves, stems, and ears) collected at the ear emergence stage from four sites in Hampshire suspected of potassium deficiency, where various fertilizer treatments had been applied, were analysed spectrographically for their mineral contents, especially potassium.

Applications of muriate of potash increased the potassium content of all organs except the ears, and decreased the manganese and sodium (most markedly in young leaves), magnesium, and iron contents on one site. The yields, which differed greatly on the four sites, were found to be significantly correlated with the potassium content of the older leaf blades and the stems, the limiting values tentatively suggested for the percentage potassium in dry matter in these organs at the time of ear emergence being 0·92 and 1·01 per cent. respectively, above which values no yield increases due to potassic manuring may be expected.

BRESADOLA (M.). **L'attività della Stazione sperimentale di Praticoltura di Lodi.** [The activity of the Experimental Station for forage growing, Lodi.]—*Ann. Sper. agr.*, N.S., 2, 4, *Suppl.*, pp. ix–xlviii, 1948. [English summary.]

In a section of this report (pp. xlv–xlvi) dealing with control of maize smut (*Ustilago maydis*) [*R.A.M.*, 18, p. 580; 27, pp. 46, 115, 468] the author states that in a two years' resistance test with a large number of varieties infection ranged from 3·57 to 14·39 per cent. in the first year, and from 9·03 to 30·48 per cent. in the second. In both years the most resistant were the Bergamo selection 2101 J.C. and Pignoletto × Scagliolo. Of 764 plants affected in the second year, 6·54, 37·69, 19·76, 26·83, and 9·16 per cent. showed infection in the foot, stem, tassel, stele and leaves, and ear, respectively.

BIRAGHI (A.). **Osservazioni e considerazioni sul disseccamento batterico del Granoturco (Xanthomonas [Aplanobacter] stewarti) in Italia.** [Observations and considerations on bacterial wilt of Maize (*Xanthomonas* [*Aplanobacter*] *stewarti*) in Italy.]—*Ann. Sper. agr.*, N.S., 2, 4, pp. 515–524, 1948. [English summary.]

Maize bacterial wilt (*Xanthomonas stewarti*) [cf. *R.A.M.*, 22, pp. 415, 474] is now present in Italy in almost every maize-growing locality on the left bank of the Po, from Piedmont to Veneto [cf. ibid., 17, p. 24; 27, p. 70]. The accounts of the disease

as it occurs in America [see next abstract] agree with what is known of the disease in Italy. In severely affected plantings in Italy yield may be reduced by 65 per cent., while losses of 100 per cent. have been reported from America. Definite evidence has been obtained that, in Italy also, the organism can be carried within the seed and transmit infection from one crop to the next. Growers in Italy report that the disease can attack severely maize growing in soil in which this crop has not been planted for a long time or in which the disease has not appeared before. Further investigations on the disease are in progress in Milan and Verona.

Poitras (A. W.) & Stevens (N. E.). **Bacterial wilt on sweet Corn, 1945–1948.**—*Plant Dis. Reptr*, 33, 3, pp. 161–165, 4 maps, 1949. [Mimeographed.]

Brief reports on the incidence of maize bacterial wilt (*Pseudomonas* [*Xanthomonas*] *stewarti*) [see preceding abstract] during 1945 to 1948 from different parts of the north-eastern area of the United States are presented. The available evidence again indicated that abundance of infection in any year was closely correlated with the temperatures prevailing during the preceding winter [ibid., 20, p. 528].

Ullstrup (A. J.) & Tucker (C. M.). **The occurrence of Phytophthora parasitica on Corn.**—*Phytopathology*, 38, 12, pp. 1029–1031, 1 fig., 1948.

Four out of 45 maize plants growing in compost soil in pots in a greenhouse at the Indiana Agricultural Experiment Station showed signs of wilting on reaching a height of 18 to 36 in. during a warm, damp spell in the winter of 1947. The spread of infection was arrested by lowering the temperature and humidity in the house and giving the plants less water.

All the leaves on a plant became involved after 10 to 14 days, beginning with the youngest. A crown rot was observed just below soil-level. The decayed area was deep brown, firm, slightly sunken, and seemed to extend slowly towards both the root and the stem. A fungus was readily isolated on tap water agar and caused typical wilting and crown rot on inoculation into healthy maize plants 12 to 30 in. in height. Mycelium of the isolate placed over maize grains planted in sand induced complete rotting before emergence. Grimes Golden apples inoculated with the maize pathogen developed a soft, brown rotted area 4 to 5 cm. in diameter after 96 hours' incubation. During the same period the invasion of potato tubers was very limited. Mycelium applied to the unwounded surface of green tomato fruits produced typical buckeye rot symptoms [*R.A.M.*, 3, p. 247 *et passim*] within 72 hours. From its morphological and cultural characters, growth at critical temperatures, and symptomatology on tomatoes, the maize pathogen was identified as *Phytophthora parasitica*. In comparative inoculation experiments with the maize isolate and one of the same species from a greenhouse at Columbia, Missouri, where buckeye rot had been prevalent in a recent tomato crop, both proved to be pathogenic to maize and tomatoes, the maize isolate being significantly more virulent than the one from tomato, but the differences were purely quantitative and not sufficiently important to warrant separation into physiologic races.

The occurrence of the genus *Phytophthora* as a maize parasite is unusual, the only previous records being doubtful ones; oospores in rotted maize roots were referred by Clinton to *P. cactorum* (*Bull. Conn. agric. Exp. Sta.* 222, pp. 397–482, 1920) but may have been those of a *Pythium*; and Sideris found an unidentified species of *Phytophthora* [previously named *Pythium teratosporon* by him: *R.A.M.*, 11, p. 546] to be weakly parasitic on inoculation into maize roots.

Kunkel (L. O.). **Studies on a new Corn virus disease.**—*Arch. ges. Virusforsch.*, 4, 1, pp. 24–46, 5 figs., 1948.

Maize stunt [*R.A.M.*, 25, p. 556; 26, p. 52] has been reported in a letter from Dr. I. E. Melhus as widespread in Guatemala and other parts of Central America.

The first symptoms on potted maize plants grown in greenhouses at Princeton, New Jersey, were circular or elongated chlorotic spots at the bases of the newly formed leaves, varying in size from pin points to large blotches. The chlorotic areas spread to other leaves and extended towards the tips. At one stage when the chlorosis was confined to areas along the medium-sized veins, typical striping patterns were produced. Leaves that developed after the virus became fully systemic were chlorotic throughout. At a late stage the upper parts of stalks developed short internodes and became chlorotic and reddish; the leaves also become slightly tinged with red. The roots were sometimes stunted, resulting in the production of innumerable branches. There was an abnormal production of numerous secondary shoots in the axils of leaves and along branches bearing ears; the latter were very small in severe cases and the husks produced abnormally long tips. The seed, however, was viable and had a normal appearance. No inclusion bodies were detected.

In transmission experiments the efficiency of the vector, *Baldulus maidis* [loc. cit.] was found to be very high. In one test 100 adult insects, reared on infected maize plants, were transferred at daily intervals for 24 days to 170 healthy plants, of which 169 became infected. All plants exposed to virus-free colonies remained healthy. In another test 10 adult viruliferous leafhoppers were transferred daily, each to a healthy plant, for 26 days. Of the 240 plants that survived, 239 became diseased, while the plants exposed to control insects remained healthy.

All 34 maize varieties tested were highly susceptible to stunt. Of various grasses tested the only susceptible one was teosinte [*Euchlaena mexicana*]. The minimum incubation period of the stunt virus in maize was 26 days. The first symptoms of the disease appeared in the fifth to the eighth leaves above the inoculated one. The incubation period of the virus in the vector varied from 14 to 32 days. Fourteen days is the longest minimum incubation period reported for any plant virus in an insect vector. The virus may be retained in the vector for as long as 88 days after only one day on an infected plant.

Attention is drawn to the correlation existing between the length of incubation in the insect vectors and the length of incubation in the host of the three viruses causing streak [ibid., 27, p. 376], stripe, and stunt of maize. This correlation may depend on the rates at which the different viruses multiply and hence supports the theory that plant viruses multiply in leafhopper vectors.

WELLMAN (F. L.). **A list of Maize diseases from a limited area in Costa Rica.**— *Plant Dis. Reptr*, 33, 2, pp. 81–85, 1949. [Mimeographed.]

A number of diseases have occurred during the last few months on maize grown under humid, tropical conditions at the Inter-American Institute of Agricultural Sciences, Costa Rica. The pathogens so far identified by the author and Miss L. HASTINGS are listed alphabetically, together with brief descriptions of symptoms and severity of the diseases, and include *Bacterium* [*Xanthomonas*] *stewarti*, *Gibberella fujikuroi*, *Physoderma zeae-maydis* [*P. maydis*], *Ustilago maydis*, and *X. vasculorum* [I.M.I. maps Nos. 41, 102, 106, 93, and 3, respectively].

LEUKEL (R. W.) & WEBSTER (O. J.). **Sorghum seed treatment tests in 1948.**— *Plant Dis. Reptr*, 33, 1, pp. 38–39, 1949. [Mimeographed.]

In a further experiment on the control of sorghum covered smut (*Spacelotheca sorghi*) [*R.A.M.*, 27, p. 361], seed of Blackhull kafir and Leoti sorgo [*Sorghum saccharatum*] dusted with spores of the fungus was treated with new improved ceresan, ceresan M dust and slurry, spergon, phygon, arasan dust and slurry, phygon XL, and panogen, field plantings being made at Beltsville, Maryland, and Lincoln, Nebraska; phygon was slightly better than the newer phygon XL in smut control in Leoti, though less beneficial to emergence. New improved ceresan im-

proved emergence more than ceresan M, though both controlled smut perfectly with only one smutted head (probably accidental). Ceresan M slurry impaired emergence in kafir at 20° C. At Beltsville all the treatments gave complete control in kafir, and with the exception of the two arasan treatments, also in Leoti. At Lincoln, control in kafir was almost perfect (three infected heads), but in Leoti only the mercury treatments were completely successful. Attention is drawn to the perfect control given by panogen [ibid., 25, p. 207; 27, pp. 421, 456, *et passim*] used at 2 or 3 c.c. per kg. or about 2 or 3 oz. per bush.

Sempio (C.). **Su una alterazione parassitaria del Limone in serra (nota preventiva).** [A parasitic disorder of hothouse Lemon trees (a preliminary note).]—Reprinted from *Ann. Fac. agr. Univ. Perugia*, 4, 7 pp., 1946. [Received 1949.]

A disease causing desiccation and shedding of the mature leaves and often the year-old branches of hothouse lemons has been known in parts of Umbria and the Marches for some years. Young fruits suffer more severe attacks than older ones; the smallest gradually turn brown and become mummified. The older ones appear dark chestnut brown and become hardened. Inoculations made towards the end of February on 13 healthy seedlings, using 13 isolates of a fungus from diseased fruits and branches, produced on seven of the seedlings towards the end of March symptoms similar to those occurring in nature. When further inoculations with the seven virulent isolates from the previous experiment were made in April the only symptom produced was a gummy secretion exuded from the inoculation wounds.

Kiely (T. B.). **Black spot of Citrus in New South Wales coastal orchards.**—*Agric. Gaz. N.S.W.*, 60, 1, pp. 17–20, 5 figs., 1 diag., 1949.

Citrus black spot [*Guignardia citricarpa*: *R.A.M.*, 27, p. 562] is most serious on late Valencia oranges in New South Wales, but lemons and grapefruit are affected to a lesser extent under central coast conditions. Mandarins and Washington Navel oranges are affected on the north coast where winter conditions are somewhat warmer when the fruit is maturing.

Leaves of several indigenous bush shrubs, namely the waratah [*Telopea speciosissima*], the wild sarsaparilla [*Smilax glycyphylla*], the turpentine tree [*Syncarpia laurifolia*], the Christmas bush [*Prostanthera lasiantha*], and the red-flowering bottlebrush [*Callistemon lanceolatus*] and also camellias, magnolias, and the bush orchid harbour latent infections. These hosts are not regarded as such dangerous sources of infection as dead citrus leaves, but their presence makes eradication of the disease virtually impossible.

Godfrey (G. H.) & Ryall (A. L.). **The control of transit and storage decays in Texas Lemons.**—*Bull. Tex. agric. Exp. Sta.* 701, 24 pp., 4 figs., 1948.

The results of experiments conducted at the Lower Rio Grande Valley Station, Texas, from 1939 to 1946 for the control of stem-end rot (*Diplodia natalensis*) [*R.A.M.*, 28, p. 64 and next abstract] and green and blue moulds (*Penicillium digitatum* and *P. italicum*) [ibid., 27, p. 233], which cause serious losses to lemons in transit and storage, showed that decay could be reduced consistently from between 10 and 85 per cent. to from 0 to 5. The freshly harvested fruit should be dipped for one to two minutes in a 4·5 to 5 per cent. solution of sodium metaborate (metbor), or 1·2 per cent. dowicide A, plus wetting agent (0·1 per cent. vatsol OS) and rinsed in water to which a disinfectant must be added. In the colouring room the fruits may be subjected either to nitrogen trichloride gas [loc. cit.], or, after colouring, dipped again in one of the above solutions, waxed, and wrapped individually in diphenyl wraps. The supplementary treatments are recommended especially for Eureka lemons. Extreme care to avoid bruising or breaking the rinds should be exercised at all stages of handling.

Ryall (A. L.) & Godfrey (G. H.). **Dip and gas treatments for the control of post-harvest decay in Texas Lemons.**—*Phytopathology*, 38, 12, pp. 1014–1018, 1 graph, 1948.

At the Texas Agricultural Experiment Station in 1946–7 the treatment of Eureka and Meyer lemons with nitrogen trichloride [see preceding abstract] at concentrations ranging from 0·003 to 0·04 p.p.m., applied for two to four periods of about four hours each during de-greening, materially reduced the incidence of stem-end rot (*Diplodia natalensis*) and blue and green moulds (*Penicillium italicum* and *P. digitatum*). The first-named pathogen predominated in the early and late October and December pickings, and the other two (especially *P. digitatum*) in those of January. For instance, in a lot picked on 9th December, the amount of rotting from all sources 17 days after packing was reduced from 26 to 3·5 per cent. by the gas treatment at 0·03 p.p.m. In the early January lots there was over 29 per cent. decay due to the blue and green moulds and under 1 per cent. stem-end rot ten days after packing, the corresponding figures for the fruit treated with 0·04 p.p.m. nitrogen trichloride being 4 per cent. for *P. digitatum* and 0·5 per cent. for *D. natalensis*, respectively.

Two quaternary ammonium compounds and sodium metaborate were only moderately fungicidal at the concentrations tested, but in combination with the gas treatment they somewhat enhanced its effects.

Smith (A. L.). **Control of Cotton wilt and nematodes with a soil fumigant.**—*Phytopathology*, 38, 12, pp. 943–947, 1 fig., 1948.

This is an amplified account of the successful experiments on the control of cotton wilt (*Fusarium oxysporum* f. *vasinfectum*) [*F. vasinfectum*] and nematodes by means of soil treatment with dowfume W-10 (10 per cent. ethylene dichromide and 90 per cent. naphtha B), a preliminary note on which has already appeared [*R.A.M.* 28, pp. 15, 125].

Arndt (C. H.). **An evaluation of certain substituted phenol esters for the treatment of Cotton seed.**—*Phytopathology*, 38, 12, pp. 978–987, 1 fig., 1948.

At the South Carolina Agricultural Experiment Station cotton seeds infected by *Colletotrichum* [*Glomerella*] *gossypii* [*R.A.M.*, 25, p. 261] were treated with various substituted phenyl esters and the seeds germinated in sand culture at 24° C. At comparable dosages, the acetate of 2,4,5-trichlorophenol was effective in the prevention of seedling infection by *G. gossypii*, the formate and propionate esters slightly less so, and those of carbonate, succinate, and laurate ineffectual. The substitution of bromine for chlorine in the 2,4,5- and 2,4,6-trichlorophenyl acetates did not materially affect their efficiency. The position of the chlorine atoms in the benzene ring, however, did influence the fungicidal properties of the compounds. Thus, the 2,3,4,6-tetrachlorophenyl acetate was more toxic both to the pathogen and its host than the 2,4,5, while the chemicals with the chlorine atoms in the 2,4,6, the 2,3,6, and the 2,3,4,5,6 positions were rather less effective fungicides. The results of field plantings were in general agreement with those of the laboratory, and indicated that seedox (the trade name of a dust containing 50 per cent. 2,4,5-trichlorophenyl acetate) at a dosage of 1 gm. per kg. seed is a satisfactory treatment for the elimination of anthracnose from fuzzy cotton seed.

Leding (A. R.) & Brinkerhoff (L. A.). **The effect of soaking Cotton seed on the incidence of angular leaf spot in New Mexico and Arizona.**—*Phytopathology*, 37, 12, pp. 974–977, 1948.

Tests were carried out in 1942, 1943, and 1944 in New Mexico and Arizona to determine the efficiency of Boughey's method for the control of angular leaf spot

[blackarm] of cotton (*Xanthomonas malvacearum*) by 48 hours' soaking of the seed at room temperature followed by air-drying [*R.A.M.*, 21, p. 198] with various modifications dictated by local conditions. Not only did the treatment fail to eliminate natural and artificial infection but in nearly all the trials the incidence of blackarm was appreciably increased, e.g., from 4·1 to 30·3, 9·7 to 58·1, 1·3 to 28·1, 0·9 to 24·2, 0·6 to 26·6, 1 to 18, and 26·7 to 69·2 per cent. Evidently, therefore, the mechanism responsible for the efficacy of the water-soaking practice in Sudan is not operative in the United States. The resultant increase of primary infection may, in fact, be of economic significance in Arizona and New Mexico, where growers occasionally soak fuzzy seed before planting to ensure rapid germination.

Lyle (E. W.), Dunlap (A. A.), Hill (H. O.), & Hargrove (B. D.). **Control of Cotton root rot by Sweet Clover in rotation.**—*Bull. Tex. agric. Exp. Sta.* 699, 21 pp., 6 figs., 1948.

The results are presented of a five-year (1943 to 1947) investigation at the Blackland Experiment Station, Texas, on the efficacy of winter and winter-summer crops of yellow annual sweet clover (*Melilotus indica*) and hubam (*M. alba* var. *annua*) in rotation with cotton for the control of root rot (*Phymatotrichum omnivorum*) [*R.A.M.*, 26, p. 379].

When the sweet clovers were used as green manure crops (ploughed under in early spring) and followed by cotton the same year, the appearance of root rot was delayed, its incidence reduced, and yields mostly increased, but the beneficial effects were still more marked in the two-year rotation with hubam. In the latter series of plots, the incidence of root rot over the four-year period from 1944 to 1947 was reduced from 29 to 5 per cent. and yield increased by 56 per cent. There was also a smaller increase in the cotton yield in the third year after hubam. The degree of root rot control, as shown by the increased cotton yield in plots following mature hubam the previous year, is proportional to the reduction in the number of cotton plants killed by the fungus early in the season. Late-season root rot is less detrimental to production. The favourable effects of *M. alba* var. *annua* in the rotation seemed to diminish with successive cotton plantings, necessitating the ploughing-under of the mature crop every third or fourth year for best results.

Cheo (C. C.). **Notes on fungus-growing termites in Yunnan, China.**—*Lloydia*, 11, 2, pp. 139–147, 10 figs., 1948.

In this paper is presented some of the information already published in Chinese (*Science* (China), 27, pp. 25–51, 1945). Seven species of termites are reported for the first time as cultivating fungi in Yunnan, China. It is suggested that the growth of *Collybia albuminosa* [*R.A.M.*, 24, p. 17] (especially the white 'conidial sphere' [*Termitosphaera*: ibid., 15, p. 500] stage) and the simultaneous suppression of species of *Xylaria* on termite-inhabited combs are interdependent features. On artificial culture media and in the absence of termites *Xylaria* spp. grow much faster. The comb for fungus cultivation is probably started by the winged, sexual form and its descendant workers, a method which differs from that used by the leaf-cutting ants. The supposition that fungus-growing combs are made from faeces has not been confirmed.

Mains (E. B.). **Cordyceps bicephala Berk. and C. australis (Speg.) Sacc.**—*Bull. Torrey bot. Cl.*, 76, 1, pp. 24–30, 4 figs., 1949.

The author refers to *Cordyceps australis* [cf. *R.A.M.*, 14, p. 443; 20, p. 575] several collections of a *Cordyceps* infecting ants in Liberia, where it is stated to be a common parasite, killing ants by thousands in the Western Province. The fungus is described (from material from various herbaria) as having ovoid to ellipsoid

heads with entirely embedded, oblique, conoid perithecia overlapping upwards and measuring 720 to 960 by 230 to 336 μ. The cylindrical asci measure 500 to 720 by 4 to 5 μ and have a thin wall which thickens over the apex. The fusoid cylindrical filiform ascospores are multiseptate, breaking into one-celled part-spores, are slightly narrowed and rounded at the ends, and measure 6 to 10 by 1 to 1·5 μ.

Petch concluded that *C. australis* was a synonym of *C. bicephala*, but examination of a slide from Kew Herbarium leads the author to support Kobayasi (1941) [loc. cit.] in excluding the latter name, as based on an immature specimen.

Muskett (A. E.). **The diseases of Linseed and Flax.**—*J. Inst. Corn agric. Merch.*, 1, 3, pp. 96–99, 1948.

This is a brief account of the fungal diseases of linseed and flax [*R.A.M.*, 28, p. 215] in Great Britain caused by seed- and soil-borne parasites, their control, and the time of sowing in relation to the health of the flax crop.

Colhoun (J.). **Varietal resistance of Flax to disease.**—*Ann. appl. Biol.*, 35, 4, pp. 582–597, 1948.

In field experiments carried out from 1941 to 1947 (at Belfast, Northern Ireland), in which infested seed was used, 33 flax fibre and oil varieties were tested for their reaction to stem-break and browning (*Polyspora lini*) [*R.A.M.*, 27, p. 523], seedling blight (*Colletotrichum linicola*) [ibid., 27, p. 236], foot rot (*Phoma* sp.) [loc. cit.], and rust (*Melampsora lini*) [ibid., 26, p. 488]. In the case of *C. linicola* additional tests were made with seedlings grown under greenhouse or laboratory conditions and inoculated with the pathogen. None of the varieties tested was immune from any of the first three organisms. Of the fibre varieties, Herkules, Concurrent, and Linkopis were highly resistant to the stem-break phase of *P. lini*, the first two varieties showing also a considerable resistance to the browning phase. Of the oil varieties, Hindi, La Plata, Saginaw × Ottawa 770B, and Winona × Ottawa 770B were highly resistant. La Plata, Hindi, and Bison were resistant to attacks by *C. lini*, while the first two also showed a marked resistance to *Phoma* sp. None of the fibre varieties was resistant to these two pathogens, but Formosa, Stakhanovets, Textilshchik, U.S.S.R. No. 2 (ex Dugejheshchya), and Wada were highly resistant to the uredospore stage of *M. lini*, while the oil varieties Argentine Selection (C.I. 112), Bolley Golden (C.I. 644), Bombay (C.I. 42), Italia Roma (C.I. 1005–2), Koto (C.I. 872), Ottawa 770B (C.I. 355), Pale Blue Crimped (C.I. 647), and Tammes Pale Blue (C.I. 333–1) were immune from both the uredospore and teleutospore stages. Baladi, Hindi, Kenya (C.I. 709–1), Newland (C.I. 188), and C.I. 836, and the fibre varieties U.S.S.R. No. 2 and Textilshchik were immune only from the teleutospore stage. The fibre varieties resistant to the uredospore stage and also Percello and 6/1 × Livonian II 2K 3/1 were also highly resistant to the teleutospore stage. *M. lini* is seed-borne in the sense that it is carried on small pieces of flax detritus mixed with the seed. The seeds harvested from the varieties tested in the field were heavily infested with *P. lini* (except La Plata), *C. linicola*, and *Phoma* sp.

Pasmo disease of Linseed. First occurrence in New South Wales.—*Agric. Gaz. N.S.W.*, 60, 1, p. 10, 1949.

Pasmo disease of flax caused by *Sphaerella linorum* [*R.A.M.*, 27, p. 322] has been recorded for the first time in New South Wales on linseed plants in the Walla Walla district. It is reported to be general in this district and may have been carried there as wind-borne spores from Victoria.

Millikan (C. R.). **Lower leaf scorch of Flax.**—*J. Dep. Agric. Vict.*, 46, 11, pp. 511–517, 2 figs.; 12, pp. 566–576, 8 figs., 1948; 47, 1, pp. 37–40, 1949.

Lower leaf scorch of flax due to manganese toxicity [*R.A.M.*, 27, p. 322] has

occurred in the Western, Central, and Gippsland districts of Victoria, Australia, each season from 1942 to 1948 inclusive. The disorder becomes apparent in late August or early September and increases in severity until about the middle of October, after which the plants tend to recover. It occurs commonly in flax sown in areas newly brought into cultivation, or ploughed up pastures. Although it is present usually in well defined patches, or evenly distributed throughout the crop, sometimes only isolated parts of individual rows are affected. The patchiness was related to the irregular distribution of superphosphate fertilizer.

The plants are very stunted; necrosis starts at the tips of the lower leaves and progresses until the distal half is light brown, while the remaining part is relatively green. In very severely affected plants the apical region may be chlorotic, the main shoot may die, and secondary shoots, often chlorotic, may form from the crown node. Plants which partially recover are shorter and mature later than the healthy ones. Soils in which affected plants were growing contained a very high proportion of soluble manganese.

The study includes a survey of relevant literature dealing with the manganese status of plants, particularly the flax plant, in relation to calcium-manganese and manganese-molybdenum antagonism [loc. cit.], soil management, reaction, water-logging, and sterilization, and the effects of superphosphate, ammonium sulphate, potassium sulphate, and sodium chloride on these relationships.

In the second article pot and field experiments conducted during 1945 to 1948 are described. Usually very marked growth responses and significant reductions in the amount of lower leaf scorch were obtained with superphosphate dressings, due to the presence of appreciable amounts of molybdenum impurity. On the other hand, superphosphate amendments to highly acid soils treated with heavy dressings of manganese sulphate caused a significant increase of the incidence of lower leaf scorch, owing to the increased phosphate content, which increases manganese toxicity symptoms. Sodium or ammonium molybdate caused a significant reduction in the percentages of affected plants, and small applications of the latter compound applied at sowing time were beneficial. Zinc sulphate dressings and steam sterilization induced significant increases in the severity of the disorder. Sulphur, which increases soil acidity, also greatly increased it, while lime had the reverse effect.

The third paper presents analyses of healthy and diseased plants collected from the same crop. A striking increase of manganese content in the latter, which was several times the normal concentration, was revealed. The manganese contents of seed samples from crops showing lower leaf scorch were greater than of those from healthy crops. The manganese/molybdenum ratio was much lower in healthy than in diseased plants. Some seed samples had very high zinc contents (up to 186 parts per million), but the lower leaf scorch status could not be correlated in all cases with an increased zinc concentration. Diseased plants also showed a consistently higher iron content.

GIDDINGS (N. J.). **Some studies of curly top of Flax.**—*Phytopathology*, 38, 12, pp. 999–1002, 1 fig., 1948.

Experiments were begun at Riverside, California, in the spring of 1945 to determine the relative susceptibility of 37 flax varieties to strains of the [beet] curly top virus [*R.A.M.*, 25, p. 34] and the possibility of their use for strain differentiation. All the commercial varieties tested were more or less uniformly susceptible to all the virus strains available. Young plants infected by the highly virulent strains 1, 3, 5, 6, 8, and 9 were dwarfed, distorted, and frequently killed, while the milder 2, 4, and 7 caused very little stunting or mortality but induced marked foliar distortion in the form of enlarged veins, enations, rolling, and twisting. Strain 10, rated as moderately pathogenic to sugar beets, appears to be relatively more virulent on

flax. Of 1,687 young plants attacked by the more virulent strains of curly top under greenhouse conditions, over 30 per cent. were dead in about 35 days after inoculation, while the corresponding figures over the same period for 983 infected by the less pathogenic strains and for 346 attacked by strain 10 were 4 and 14 per cent., respectively.

Plants infected by the less virulent strains often showed signs of recovery similar to those reported by Wallace for Turkish tobacco affected by the same disease [ibid., 19, p. 304]. Such plants may send out a symptomless branch below the site of the heaviest infection or they may merely continue the normal terminal growth with fewer symptoms, which may, however, reappear in the sepals enclosing the seed pod. In tests on four plants with symptomless branches the curly top virus was recovered from the terminal growth of each plant. Virus of an equivalent concentration to that in the terminal growth was present in the symptomless branches of one plant, a comparable branch in another plant contained a very low concentration, and in the symptomless branches of the other two the virus was absent.

Of four ornamental species of flax included in the trials one, *Linum grandiflorum rubrum*, was fairly susceptible to infection, while the other three, *L. lewisii*, *L. perenne*, and *L. flavum*, were highly resistant, showing no symptoms of curly top though the virus was recovered from infected plants. *L. lewisii* was tested with strains 1, 2, and 3, but virus was recovered from only one plant, that inoculated with 2. All the *L. perenne* and *L. flavum* plants inoculated with strain 6 yielded virus in reisolation tests, whereas 1, 2, 3, 7, and 10 were not recovered.

Brierley (P.) & Smith (F. F.). **American research on virus diseases of Lilies.**—*Lily Yearb., 1948*, pp. 31–35, 8 figs., 1948.

The authors' studies on lily viruses in the United States, here briefly summarized, have already been noticed in this *Review* from the original sources.

Kassanis (B.). **A necrotic disease of forced Tulips caused by Tobacco necrosis viruses.**—*Ann. appl. Biol.*, 36, 1, pp. 14–17, 1 pl., 1949.

A necrosis of tulip plants raised under glass was first observed during 1940 in three English counties and described by Moore (*Bull. Minist. Agric., Lond.*, 126). In February and March, 1948, specimens of forced tulips with apparently identical symptoms were received at Rothamsted from Mr. W. Buddin and Dr. W. A. R. Dillon Weston. The disease occurred in three different nurseries, killing 20 to 50 per cent. of the plants. The affected varieties included Alberio, Korneforus, Crater, Rose Copland and Krelage's Triumph, while others growing under the same conditions remained apparently healthy. All the plants, diseased or healthy, were raised from bulbs newly imported from Holland. The necrotic plants were found to be infected with one or more of the tobacco necrosis viruses [*R.A.M.*, 22, p. 377; 27, p. 22].

The leaves and sometimes also the stems and flowers bore numerous small, or few large necrotic spots and streaks. Small plants were often acutely necrotic and soon collapsed, while in larger ones the necrosis progressed more slowly, though death resulted eventually. Plants which produced symptoms after their flowers were developed usually had large necrotic areas often only on one half of the leaf or restricted to one half of the flower, with necrotic streaks extending over the whole length, whereas in younger plants the necrotic areas covered the whole leaf surface which was stunted, twisted, and shrivelled. Such plants rarely flowered. In occasional plants, probably infected when more mature, the flower withered and the leaves or flower stalk bore only an occasional necrotic streak. Many of the flowers on diseased plants were deformed and had abnormal numbers of floral parts, but it is not certain whether this was due to the virus infection.

Inocula from infected tulips from all three nurseries produced the typical local lesions of tobacco necrosis when rubbed on to the leaves of bean (*Phaseolus vulgaris* var. Prince), tobacco, and *Nicotiana glutinosa*. The virus was demonstrated in tulip roots, bulbs, leaves, and flowers, It occurred most abundantly in necrotic tissue, but was also present in apparently normal tissue of leaves that bore a few necrotic streaks. The roots, often with brown lesions when young, always contained the virus, while the apparently normal bulb buds contained even higher concentrations. Inoculated healthy Rose Copland, Alberio, and Korneforus tulip plants developed, a week later, symptoms resembling those of the naturally infected plants, while uninoculated ones remained healthy.

The results of serological tests showed that all the diseased tulips contained one or two viruses, all serologically related to those called tobacco necrosis viruses, and that a number of these related viruses can produce the same disease.

Limber (D. P.). **Notes on Curvularia sp. on Gladiolus, with five new distribution records.**—*Plant Dis. Reptr*, 33, 2, pp. 66–68, 1949. [Mimeographed.]

Records of *Curvularia* leaf spot of *Gladiolus* [*R.A.M.*, 27, p. 525], have been received from Mississippi, from Long Island on Vredenburg and Picardy, from North Carolina and Beltsville, Maryland, on Picardy, and from Michigan on Illinois-grown stock and Myrna. A species of *Curvularia* was cultured from corms from Florida grown near Norfolk, Virginia. The pathogen has not been reported on *Gladiolus* in any other country.

Limber (D. P.). **Sori of Urocystis gladioli on Gladiolus corm scales.**—*Phytopathology*, 38, 11, pp. 922–925, 2 figs., 1948.

Previously published illustrations of *Urocystis gladioli* [*R.A.M.*, 21, p. 258] are limited to drawings and a photograph of the spore balls. As explained by E. W. Mason [ibid., 22, p. 176], the correct designation of the fungus is *U. gladioli* W. G. Smith, not *U. gladioli* (Req.) W. G. Smith, as generally cited. The present contribution includes a photograph of the sori on *Gladiolus* corms found in a shipment from Holland, where the disease was reported to be serious by van Poeteren in 1924 [ibid., 4, p. 589]. It therefore seemed desirable to familiarize American horticulturists and plant pathologists with the aspect of the smut so that any introductions into the United States might be promptly recognized.

The unbroken sori are roughly oval, the longer axis being parallel with the veins of the scale except when several sori become confluent. The surface is roughened in parallel ridges, apparently consisting of metamorphosed veins. The greyish, leaden colour of the slightly raised sori differs little from that of the healthy scale. Those found on the Dutch material measure 4·5 to 6·5 by 1 to 55 mm. and are about 0·5 mm. in thickness.

Severin (H. H. P.) & Tompkins (C. M.). **Aphid transmission of mild mosaic virus of Annual Stock.**—*Hilgardia*, 18, 15, pp. 539–547, 4 pl., 1948.

Five species of aphids, tested in lots of 20, were shown at the California Agricultural Experiment Station to be vectors of the mild mosaic virus of annual stock (*Matthiola incana* var. *annua*) [stock mosaic virus: *R.A.M.*, 18, p. 459; cf. also ibid., 25, p. 67], viz., *Aphis medicaginis*, *Brevicoryne brassicae*, *Myzus braggi*, *M. persicae*, and *Rhopalosiphum pseudobrassicae* (the turnip aphid), of which only the last-named breeds on the virus host under natural conditions. It induces pale green, circular lesions round the mouth-part punctures and, when abundant, floral yellowing or blanching. *R. pseudobrassicae* failed to transmit the virus to nine healthy cauliflower varieties but infected 49 of 82 stock plants. Several infections of stocks were obtained with individuals of the turnip aphid and *M. persicae* kept

fasting for two hours, fed ½, 1, 2, 5, or 10 minutes on leaves from infected stock, and then transferred to healthy plants, one aphid per plant, although negative results were given by tests in which several hundreds of *R. pseudobrassicae*, *M. persicae*, and *B. brassicae* were used singly without fasting and fed for longer periods on diseased plants. In virus retention tests turnip aphids, kept fasting for 30 minutes and then fed singly for five or ten minutes on infected stock prior to transference for the same period to five or six successive healthy plants, produced infections only in the first. Batches of 20 *R. pseudobrassicae* lost their infectivity by the fourth day after transfer from a diseased to a previously healthy stock plant. However, if allowed to remain on the plant for 7 to 13 days, the aphids succeeded in recovering the virus from the host they had inoculated. This took place long before the appearance of symptoms, the incubation period of the disease in the original inoculated plants ranging from 16 to 22 days.

Roll-Hansen (F.) & Jørstad (I.). **Gyrophana lacrimans and Coniophorella umbrina noxious to ornamental plants in greenhouses.**—*Blyttia*, 6, pp. 53–54, 1948.

In a greenhouse at Lier, south-eastern Norway, the soil in the plant boxes and pots used in *Begonia* cultivation was permeated by a mass of white strands up to 1 mm. in diameter. If they were allowed to spread freely the plants died, but the removal of the infested soil during potting arrested the attack. On examination in 1946 the fungus responsible for the trouble, *Gyrophana lacrimans* [*Merulius lacrymans*], was found to have originated from the rotten boards in the plant boxes, or under the pots which were placed in peat moss lying on wooden tables.

In the late autumn of 1943, greyish, later brown flakes were observed covering the outside of *Begonia* pots in a greenhouse and spreading over the carnation beds near Grimstad, in the extreme south of the country. The flakes proved to be the sporophores of a *Coniophorella*, probably *C. umbrina*, judging by the brown hymenium and the dimensions of the encrusted cystidia (110 by 10 to 13 μ) and yellow, unilaterally flattened spores (9 to 12 by 5·5 to 6·5 μ). *Coniophorella* spp. have hitherto been known exclusively as occupants of wood, but in the present case the excessive moisture of the greenhouse probably contributed to the extension of the pathogen to another kind of material.

Wellman (F. L.). **Successful spray control of Alternaria blight of Petunias grown for seed in Costa Rica.**—*Plant Dis. Reptr*, 33, 2, pp. 69–72, 1949. [Mimeographed.]

Early in 1947 *Petunia hybrida* crops grown commercially for seed at Finca La Dominica, Costa Rica, were severely affected by leaf blight, caused by *Alternaria tenuis* [*R.A.M.*, 25, p. 579]. By April much of the foliage, stems, and flowers were dead. Natural infections on the stems, which occurred at the flowering and seed setting stages, caused small, elliptical, grey-brown lesions, from which *A. tenuis* spores were repeatedly obtained. The lesions, however, did not result in the girdling and die-back of branches, which followed infection from original leaf lesions attacking the stems by way of the petioles. Natural infections did not occur on the younger, vigorous plants. Petunias growing under narrow sheds of roofing became infected while those of the same clone planted in close proximity in the open remained healthy.

Inoculations of healthy leaves with a spore suspension induced small, dark brown, round spots within two days; they quickly expanded, measuring 7 to 27 mm. in diameter after one week, and often coalesced, covering the whole leaf. The dead leaves hung on and in the most severe cases infection spread to the petiole and finally into the stem. Subsequently the branches were girdled and the part above collapsed. Within a month the whole plant was killed.

Comparative spraying tests in 1948 showed that the best control was obtained by weekly sprayings with parzate and fermate, both at 2–100 and combined with a resin spreader sticker, the fermate also containing a small amount of wettable sulphur. Fermate caused excellent recovery of plants suffering from bad copper injury.

Gill (D. L.). **Azalea petal blight and its control.**— *Flor. Exch.*, 111, 21, pp. 14–15, 1948. [Abs. in *Chem. Abstr.*, 43, 2, p. 802, 1949.]

The destructive petal blight of azalea [*Rhododendron*] caused by *Ovulinia azaleae* in the United States [*R.A.M.*, 20, p. 119] may be effectively combated by two to three applications per week of one of the following sprays: (*a*) 1 qt. dithane D14 plus 13 oz. zinc sulphate (25 per cent. zinc), plus ½ lb. hydrated lime, with 1 fl. oz. triton B1956 (for which 4 fl. oz. dreft or 2 fl. oz. santomerse S may be substituted) diluted to 100 gals. with water; (*b*) 1¼ lb. dithane Z78 in 100 gals. and (*c*) 1 lb. parzate in 100 gals. Parzate or dithane dust at 6 per cent. also give satisfactory control. Thorough coverage of the flowers is essential.

McWhorter (F. P.) & Hardison (J. R.). **Record and diagnosis of Subclover severely injured by yellow bean mosaic virus.**—*Plant Dis. Reptr*, 33, 2, pp. 86–88, 1 pl., 1949. [Mimeographed.]

In 1948 Tallarook subclover (*Trifolium subterraneum*) grown for seed in Oregon was completely ruined by bean yellow mosaic virus disease. Evidence indicated that the infection was probably derived from a neighbouring planting of red clover (*T. pratense*) harbouring bean yellow mosaic. [This study was also published as *Tech. Pap. Ore. agric. Exp. Sta.* 553.]

Reitz (L. P.), Grandfield (C. O.), Peterson (M. L.), Goodding (G. V.), Arneson (M. A.), & Hansing (E. D.). **Reaction of Alfalfa varieties, selections, and hybrids to Ascochyta imperfecta.**—*J. agric. Res.*, 76, 12, pp. 307–323, 2 figs., 3 graphs, 1948.

Field and greenhouse experiments were made at Manhattan, Kansas, from 1938 to 1943 inclusive, to study the reaction of lucerne varieties and strains to the black stem disease caused by *Ascochyta imperfecta* [*R.A.M.*, 25, p. 118; 28, p. 18]. The plants in the greenhouse tests were sprayed with a spore suspension and incubated for 72 hours in a moist chamber. The reaction to black stem was assessed by scoring the number and size of leaf lesions, defoliation, and petiole and stem lesions, on the 0 to 5 or 0 to 10 basis. An index of infection was calculated as a percentage of total infection compared with the controls. A modification of Richards's system [ibid., 13, p. 774], in which leaves and stems were assessed separately, was used to score plants in the field.

Preliminary field trials in 1939 showed that varietal differences were statistically significant, indicating the possibility of breeding for resistance. Turkistan varieties were more susceptible than Ladak or Kansas Common. In 1942, a year favourable for infection in the field, assessments of improved strains also showed highly significant variations. A-169 from Nebraska, A-155 from Rhode Island, and 128 and A-131 from Wisconsin proved most resistant. All the foreign introductions and Arizona Chilean were very susceptible, while of the standard varieties Grimm and Dakota Common were most resistant.

In greenhouse tests to examine the reliability of the scoring method and selecting plants by means of it, the disease scores (the sum of the separate scores for stems and leaves estimated on a 0 to 10 basis) ranged from 2·38 for *Medicago ruthenica*, the most resistant variety, to 6·19 for Hairy Peruvian which was extremely susceptible. The Turkistan and Kansas Common plants ranked above the average in susceptibility, which suggests that these two varieties may react differently to

natural and artificial infection. The difference between the varieties was highly significant. The scores for size and number of leaf lesions ranged from 2·11 and 1·8, respectively, on *M. ruthenica* to 4·44 and 3·89, respectively, on Hairy Peruvian. Turkistan 19304 ranked sixth in size and ninth in number of lesions while with Kansas Common Selection the ranking was reversed, indicating that there may be two factors for leaf resistance to *A. imperfecta*, one restricting the entrance of the organism and another inhibiting its growth once it is inside. Hairy Peruvian showed the least variability for number and size of lesions, i.e., it approached complete susceptibility, while *M. ruthenica* was the most variable.

Ten plants from each of 30 selections resistant to bacterial wilt [*Corynebacterium insidiosum*] derived from Kansas Common were inoculated in the greenhouse when 8 to 10 in. high. Considerable variability within lines was found since they originated from open-pollinated plants. The plants were then cut back and re-inoculated four weeks later. A highly significant difference existed between inoculations, and the lines were significantly different. Kansas Common line 1–102–5 had the lowest average score of 82 for 7 plants.

In selecting for black stem resistance, a plant from one of the Kansas Common wilt-resistant selections and another from the F_2 generation of a Semipalatinsk by Ladak cross proved to be highly resistant to black stem.

In the first generation of inbreeding of selected resistant and susceptible varieties and species there was a significant tendency for the inbred population from each parent plant to react to black stem in the same manner as the parent. Second generation inbred progenies obtained from nine of the 18 original plants exhibited the same trend. Variation [in susceptibility] was less in the second generation. The F_2 lines from susceptible Hairy Peruvian × resistant Kansas Common and resistant Semipalatinsk × resistant Ladak carried a high degree of resistance if the parents were resistant, and proved susceptible if the parents were susceptible.

The 33 first-generation plants from a cross between the highly susceptible inbred Hairy Peruvian No. 33 used as male parent and the very resistant *M. falcata* No. 39 used as the female showed a very high degree of resistance and low variability. The results of a reciprocal cross confirmed as far as the data would permit that the resistance of the female parent was dominant.

Four cases in which the effect of inbreeding and selection among inbred lines was studied indicated the value of selecting for black stem resistance in an inbreeding programme on heterozygous material. In all cases the selection of resistant plants in the first generation tended to produce more resistant plants in the second generation than in the first, while in the case of an unselected population there was no difference in the resistance of the two generations.

Diverse collections of *A. imperfecta* were differentiated on acidified oatmeal agar. Tests on clonally propagated lucerne plants showed that strain No. 7 was significantly more virulent than either a mixture of the eight strains or any of the other seven strains individually. The index of infection was 138 for strain No. 7 and 119 for the mixture of all eight strains. The lowest index was 99 for strain No. 1.

Rowell (J. B.). **New fungicides for turf.**—*Greenk. Reptr*, 16, 4, pp. 22–23, 35, 1948.

The new fungicides tested in 1947 at the Rhode Island Experiment Station for turf disease control fell into two categories, the water-soluble phenyl mercurials and the cadmium compounds. Preparations of the former group were relatively specific against one or two fungi. For instance, PMAS (soluble phenyl mercury acetate) controlled dollar spot (*Sclerotinia homeocarpa*) on the creeping bents [*Agrostis stolonifera*] and copper spot (*Ramulispora sorghi*) on velvet bent [*A. canina*: *R.A.M.*, 26, p. 492], while puratized 641 (a coded compound related to puraturf) eliminated dollar spot on *A. stolonifera* and pink patch (*Corticium fuci-*

forme) on *A. canina*. Puraturf was effective against copper spot but not dollar spot or pink patch at the recommended dosage. Overdosage or uneven distribution of PMAS and puraturf tends to damage the turf, and as a group the cadmium compounds show a wider margin of safety, applications at four times the recommended strength being non-injurious. Two inorganic forms, cadmium and Crag No. 531 (calcium zinc copper cadmium chromate), controlled dollar spot and pink patch but not copper spot. The most efficient of the preparations tested were four organic cadmium compounds, puratized 177 (*p*-amino phenyl cadmium dilactate) [ibid., 26, p. 528], and three new experimental formulae, which eliminated all three pathogens. They also appeared to exert a high residual activity in the sod. Four monthly treatments with puratized 177 at 2 lb. per 100 gals. water were equally effective against all three diseases with eight bi-weekly applications at the recommended dosage of 1 in 100.

Growers with a complex disease problem in the Rhode Island area are advised to follow a bi-weekly spray programme with alternating treatments of a cadmium and mercurial compound to utilize the best qualities of the two groups. The treatments should start in mid-May with a cadmium fungicide, to be repeated in the middle of June, July, August, and September, while the mercurial preparation would be applied on 1st June, July, and August.

Streets (R. B.). **Diseases of Guar (Cyamopsis psoraloides).**—Abs. in *Phytopathology*, 38, 11, p. 918, 1948.

Guar (*Cyamopsis psoraloides*), grown in Arizona as a summer green manure crop and for the monogalactan gum of the seeds, is subject, among other diseases and injuries of minor importance, to infection by the root rots due to *Phymatotrichum omnivorum*, *Fusarium* and *Rhizoctonia* spp., and *Sclerotium rolfsii*. The branched Mesa variety is highly resistant to *P. omnivorum*, while the unbranched, early maturing Texsal is fairly susceptible to this form of root rot but resistant to *S. rolfsii*. Mosaic [virus] reduced the seed yield by up to 50 per cent. in 1943, but has not reappeared. *Alternaria* leaf spot [*R.A.M.*, 15, p. 78], the only common foliar disease, may cause more or less extensive defoliation under abnormally humid conditions.

Moore (M. H.). **An experiment in applying undiluted lime-sulphur to Apple trees.**—*Rep. E. Malling Res. Sta., 1947*, pp. 129–131, 2 pl., 1948.

In an experiment made to ascertain how apple trees would react to lime-sulphur applied without water dilution, dwarf-pyramid trees of five varieties were treated on 26th June in hot sunny weather with (1) undiluted lime-sulphur spray, (2) atomized 2½ per cent. lime-sulphur, (3) normal, and (4) atomized lime-sulphur. A volume of 37 fl. oz. of the 2½ per cent. dilution was atomized on to 30 trees and 16 fl. oz. of the undiluted on to a further 30; 11 pints of the concentrate were hand-pumped on to 24 trees, and 14 pints of the 2½ per cent. dilution on to 30 trees. The following day there was a storm of drenching rain.

On 7th July trees of all varieties sprayed with the concentrate showed scorch of the oldest and youngest leaves with some malformation. The intermediate leaves, though heavily coated with a whitish deposit on both surfaces, were virtually free from scorch and appeared to be normal. There was no leaf drop. Lane's Prince Albert sprayed with 2½ per cent. showed suffused browning or reddening of the oldest leaves and a slightly sickly pallor of the rest of the foliage, while those given the atomized concentrate showed a suggestion of general pallor.

On 8th September some of the fruits of all varieties sprayed with the concentrate, especially Lord Derby, showed localized blackening round some lenticels at the calyx end. Some of the Lane's fruits displayed a reddish-brown patch on the skin facing south. A few fruits had dropped. All the fruits, as well as the trees,

still bore a thick spray deposit. Of those treated with atomized concentrate a few Lord Derby apples had a trace of lenticel darkening. Most of the trees gave a very good crop.

PARKER (W. B.). **Seventeen years' progress in development of the 'Vapo-duster'.**—*Agric. Chemicals*, 3, 11, pp. 22–24, 13 figs., 1948.

The progress made in the development of the 'Vapo-duster' (fog spray) since it was built in 1931 for insect control in the San Joaquin Valley, California, is described by means of photographs. It is now possible to use this equipment to apply concentrated liquid fungicides to orchards, truck crops, and shade trees.

CAVILL (G. W. K.), PHILLIPS (J. N.), & VINCENT (J. M.). **Relationship between fungistatic activity and structure in a series of aromatic compounds.**—*J. Soc. chem. Ind., Lond.*, 68, 1, pp. 12–16, 1 diag., 1949.

The fungistatic activity of 127 benzene derivatives against *Aspergillus niger* is tabulated and discussed in relation to molecular structure and, in less detail, to solubility [cf. *R.A.M.*, 27, p. 143]. The aromatic nucleus is more effective than its saturated counterpart. The effect of hydrophilic and nitro groups substituted in the benzene ring can differ markedly according to the position of substitution relative to groups already present. Halogen substitution is generally advantageous and is less affected by position. Nuclear substituted 4-hydroxybenzoates seem to approximate in their biological behaviour to substituted benzoic acids rather than to substituted phenols. The introduction of alkyl groups and alkyl esterification and etherification are generally beneficial, although the increased activity usually approaches an upper limit in the alkyl series relatively early (three to six carbon atoms). The carboxyl structure of the acid and ester appears to be important, since the analogous carbon compound is definitely less active. Methylene groups between the benzene nucleus and the carboxyl group reduce efficiency.

Although there is evidently a general trend between inhibiting activity and decreasing water solubility, the data available for 34 compounds show many deviations from a simple linear relationship between the logarithms of both properties. An approximate ratio between the solubilities in ethanol and water of 23 compounds reveals a rather more significant relationship. However, discrepancies remain both in respect of *A. niger* itself and between the authors' results with this organism and those, e.g., of Greathouse and Rigler with *Phymatotrichum omnivorum* [ibid., 21, p. 75] and Walker and Link with *Colletotrichum circinans* [ibid., 14, p. 553], which suggest the operation of more specific factors than those covered in simple solubility data.

VAN DER PLANK (J. E.). **The relation between the size of fields and the spread of plant-diseases into them. Part II. Diseases caused by fungi with air-borne spores, with a note on horizons of infection.**—*Emp. J. exp. Agric.*, 17, 65, pp. 18–22, 1949.

The author examines further the relation between size of fields and the movement of plant diseases [cf. *R.A.M.*, 28, p. 50], particularly the movement of fungus spores by air between fields. Over distances long enough to be appropriate to the movement of infection between fields, the probability of a spore settling and causing infection at a distance x from its source is determined approximately and empirically as $p = k/x^n$, where k is a constant and n, determined from records for dispersal over distances greater than 30 m., has a value of at least 2 and sometimes approaches 4.

If fields are made larger and correspondingly fewer without change in shape, aspect, or uniformity of distribution, the movement of fungus spores by air between them decreases, the proportion of spores transferred from field to field varying

inversely as $A^{\frac{1}{2}(n-1)}$, where A is the average area of the field. As pronounced gradients are usually absent from large and small fields, it is accepted that the somewhat greater retention of spores in enlarged fields does not influence the multiplication of disease. It is not possible by methods of hygiene to maintain for long a completely healthy area in a region in which infection is moving over considerable distances. But it should be possible, by enlarging fields or using any other hygienic measure, to obtain partial local control provided $n = 3$ or more. The determination of n, whether its value is constant or a function of x or other variables, is of great importance in practical plant pathology. Its value probably depends to a great extent on the climatic conditions that prevail during spore dispersal; and there may be a hint in the fact that both *Phytophthora infestans* and *Peronospora destructor*, for which there are some indications that n approaches 4, need humid conditions for their spread.

Proceedings of the Society for General Microbiology.—*J. gen. Microbiol.*, 2, 3, pp. xvii–xxxii, 1948.

In a symposium on 'Microbial association: soil water and sewage', P. W. Brian dealt with the production of antibiotics in relation to the ecology of soil-inhabiting micro-organisms. A considerable proportion of these organisms possess the power of producing antibiotic substances in culture and there are indications that they can produce them in the soil under certain conditions. Consideration of the stability in soil of certain pure antibiotics indicates that instability does not deprive them of biological significance in soil. Those which are relatively stable chemically are most likely to be of significance in connexion with biological equilibria in soil.

Dealing with the growth of fungi in percolating filters in relation to the strength of sewage treated, T. G. Tomlinson points out that in the standard process of biological filtration one of the chief factors limiting rate of treatment of sewage is the accumulation of fungus mycelium in winter. The fungus is disintegrated by the renewed activity of the filter metazoa and in particular by insect larvae in spring and early summer. When sewage was diluted with an equal volume of filter effluent, the growth rate of fungal film was reduced to one-fifth and ceased when the biochemical oxygen demand of the sewage was reduced to under four parts per 100,000. The alternate treatment of a filter with sewage and partially purified filter effluent reduces the rate of fungal growth and allows bacterial decomposition of the mycelium to take place.

R. Markham states that turnip yellow mosaic virus [see above, p. 261] has been isolated from several cruciferous plants. The preparations are homogeneous on electrophoresis and show a moderately constant composition on ultracentrifugation, but contain two components of different sedimentation velocity. The more slowly sedimenting material consists of the virus protein alone, while the other is a nucleo-protein with a high nucleic acid content. The two components appear to differ only in weight, both having the same crystalline form. There is much evidence that the nucleic acid of the virus is held inside a spherical shell of protein which may need to be combined with nucleic acid to cause infection.

R. E. F. Matthews states that as turnip yellow mosaic virus can be obtained with and without nucleic acid bound in the protein, it is possible to study the rôle of the nucleic acid in the antigenic behaviour of the virus. The virus containing nucleic acid is highly antigenic, while the protein free from nucleic acid is much less so. Because of the presence of small amounts of virus containing nucleic acid in the author's preparations he was unable to determine whether loss of antigenicity was complete. Quantitative studies on the reaction of the virus with antibody *in vitro* showed that the velocity of the reaction and the amount of antibody which combines with a given weight of virus protein appear to be identical for the nucleoprotein and the virus without nucleic acid.

Lindegren (C. C.). **Genetics of the fungi.**—*Ann. Rev. Microbiol.*, 2, pp. 47–70, 5 figs., 1948.

This is a critical review, based on the literature, of the present state of knowledge of the genetics of fungi [*R.A.M.*, 28, pp. 25, 72]. The subjects treated are Mucorales, Schizomycetes, Hymenomycetes, smuts, rusts, *Saccharomyces*, *Neurospora*, *Venturia*, *Glomerella*, *Penicillium*, and selective agents. A bibliography of 63 references is appended.

Welsch (M.) & Salmon (J.). **Préparations permanentes de spores de champignons.** [Permanent preparations of fungus spores.]—*C.R. Soc. Biol., Paris*, 142, 23–24, pp. 1587–1588, 1948.

A simplified method of making permanent spore preparations of the larger fungi has been developed. The sporophores are placed on a sheet of cellophane so that the spore deposit can be examined against a background of any tint which will throw the spore colour into relief. A 1 cm. square is then cut from the spore-covered cellophane and stuck on a slide with a small drop of Canada balsam. A large drop of a very dilute, practically colourless solution of the same preparation is then placed on the upper surface; in this way the colour of the spores, which remains unchanged, can again be studied against an appropriate background. The use of chloroform instead of xylol as a medium for the balsam prevents the occasional distortion of thin-walled spores in the mounting process.

Goldzweig (Miriam). **On some cellulose-splitting fungi of Palestine.**—*Palest. J. Bot.*, J. Ser., 4, 2, pp. 107–108, 1947. [Received February, 1949.]

Decomposition of cellulose was effected in two or three days by *Sporotrichum roseum*, two unidentified *S.* spp., *Chaetomium spirale*, *C. globosum*, and *Helminthosporium anomalum* (all isolated from soil), and by *C. murorum* and *C. bostrychodes* [*R.A.M.*, 24, p. 330] from books; and in six days by *Alternaria humicola* [ibid., 26, p. 369; 28, p. 141] from soil.

The fungi were grown on the jelly-like cellulose membranes produced by *Acetobacter xylinum* in alcohol- and sugar-containing fluids as described by Aschner (*J. Bact.*, 33, pp. 249–252, 1937) and sterilized and immersed in Czapek's salt solution prepared without saccharose.

White (W. L.). **Activities and interrelationships of microorganisms responsible for the deterioration of industrial and military materials.**—Abs. in *Amer. J. Bot.*, 35, 10, p. 804, 1948.

Studies on the identity, activities, and interrelationships of the micro-organisms causing deterioration of military materials under humid tropical conditions [*R.A.M.*, 27, p. 486; 28, p. 188], carried out mainly at the Quartermaster Corps Biological Laboratories, Harvard University, showed that in routine isolation procedures the causal organism was often submerged by faster growing forms which had settled on the material in atmospheric dust. A single species was usually found to be predominant on any given sample. In so far as has been determined the organisms are antagonistic towards one another [cf. ibid., 27, p. 439]; no case of mutual assistance can be cited. In the laboratory the use of mixed inoculum produced decomposition more slowly than the most potent components acting alone. Under field conditions the behaviour of a species was sometimes in sharp contrast to that expected as a result of laboratory experiments. Although the decay organisms in general were widely distributed, detailed studies showed that they had interesting geographic patterns and considerable specificity for materials and environmental conditions.

Perlman (D.). **Production of penicillin on natural media.**—*Bull. Torrey bot. Cl.*, 76, 2, pp. 79–88, 1949.

Natural materials, including cottonseed meal, linseed oil meal, coco-nut oil meal, sardine meal, groundnut oil meal, mustard flour, soy-bean oil meal and possibly castor bean meal, are able to replace maize steep liquor in penicillin production [*R.A.M.*, 27, pp. 33, 253], the penicillin yields being equally high. The composition of the inoculum medium under certain conditions has a marked effect on the fermentation, the nitrogenous material present being probably much more important than the carbohydrate source.

Robbins (W. J.), Kavanagh (F.), & Hervey (Annette). **Synergism between some antibacterial substances.**—*Bull. Torrey bot. Cl.*, 75, 5, pp. 502–511, 3 figs., 1948.

In the course of an investigation of antibacterial substances produced by some Basidiomycetes [*R.A.M.*, 27, p. 252], agar disks containing approximately 50 μgm. streptomycin per ml. and disks cut from a colony of *Poria corticola* were tested on yeast-peptone agar, seeded with the indicator bacterium *Bacillus mycoides*, and incubated at 30° C. When the disks were placed with their edges 11 mm. apart, the bacterial colonies which were expected to appear between them did not develop. Visible antibacterial action of the streptomycin, which extended 3 mm. from the edge of the disk when it acted alone, was observed to a distance of 11 mm. when in the presence of the antibacterial materials from *P. corticola*. The disks of *P. corticola*, which partially inhibited the bacteria up to a distance of 11 mm. from the edge when alone, induced action at a distance of 16 mm. in the presence of streptomycin as shown by the elimination of resistant colonies in the vicinity of the streptomycin disk. Much the same interaction was observed when other test bacteria were used.

When the synergistic action between streptomycin and culture liquids of *P. corticola* and *P. tenuis* was tested in beef extract and yeast-peptone broth, one-quarter of the minimal inhibitory concentration of streptomycin doubled the activity of the culture liquid of *P. corticola*, and one-half the minimal inhibitory concentration increased it 16 times. Similarly, one-fourth the minimal inhibitory concentration of the culture fluid of *P. corticola* doubled the activity of streptomycin in one experiment.

Bailey (J. H.) & Cavallito (C. J.). **Antibiotics.**—*Ann. Rev. Microbiol.*, 2, pp. 143–182, 1948.

The authors present a critical review of the present state of knowledge concerning antibiotics [*R.A.M.*, 28, p. 138], the subjects treated being Actinomycetes, animal, bacterial, fungal, and plant antibiotics, the mechanism of their action, and the resistance shown to them. A bibliography of 238 items is appended.

Reynolds (E. S.). **Pullularia as a cause of deterioration of paint and plastic surfaces in South Florida.**—Abs. in *Amer. J. Bot.*, 35, 10, p. 803, 1948.

Investigations made at Miami, Florida, have shown that serious mould injury to paint and plastic surfaces exposed in the open was due mainly to *Pullularia* developing in the form of numerous minute, dark dots.

Berk (S.). **Fungicidal treatments for cork gaskets.**—*Industr. Engng Chem.*, 41, 3, pp. 627–633, 2 figs., 1949.

Seven fungicidal treatments for cork gaskets which showed promise in the experiments previously reported [*R.A.M.*, 27, 436] were applied to both protein- and resin-bonded samples and appraised on the basis of the following criteria:

mycological tests (using *Aspergillus niger*, *Chaetomium globosum*, *Penicillium* sp., and *Trichoderma* sp.) in the laboratory, and field exposures at a tropical testing site in the Panama Canal Zone; resistance of the treated gaskets to fungal attack after storage at high temperatures and leaching by water; physical tests to determine whether fungicidal treatment of the gaskets resulted in deterioration; corrodibility of the treated gaskets to metals; and toxicity to personnel handling the treated cork.

The samples treated with 2 per cent. *p*-nitrophenol in water, 1 per cent. of multiple fungicide containing *p*-nitrophenol and sodium alkyl aryl sulphonate, and 2 per cent. *p*-nitrophenol plus paraffin wax proved completely resistant to invasion by the four above-mentioned moulds after 28 days' storage at a temperature of 39°±1·5° C. The treated gaskets did not disintegrate on immersion in boiling water, hot motor oil, or gasoline. The results of leaching tests indicate, however, that where the treated material is liable to protracted periods (upwards of 24 hours) of leaching by water, the initial concentration of the fungicide will have to be increased. In the case of *p*-nitrophenol it must exceed 2 per cent. with a concentration of the fungicide on the cork greater than 0·55 per cent.

In the corrosion tests the treated gaskets were placed between strips of aluminium, steel, brass, and zinc-plated steel and exposed to 100 per cent. relative humidity. No corrosion was caused by treatment with 1·7 per cent. *p*-nitrophenol in fuel oil, and the slight amount produced by the 2 per cent. concentration on aluminium and zinc-plated steel is not regarded as a hindrance to its practical use. On the basis of all the tests conducted, a 2 per cent. aqueous treatment of *p*-nitrophenol is recommended for the mould-proofing of automotive cork gaskets.

Slankis (V.). **Einfluss von Exudaten von Boletus variegatus auf die dichomotische Verzweigung isolierter Kiefernwurzeln.** [Influence of exudates of *Boletus variegatus* on the dichotomous branching of isolated Pine roots.]—*Physiol. Plant.*, 1, pp. 390–400, 8 figs., 1948.

As part of a study at the Institute for Physiological Botany, University of Uppsala, Sweden, on the factors affecting the growth of isolated pine roots in pure culture, the influence of the mycorrhizal fungi, *Boletus variegatus*, *B. luteus*, and *Cenococcum graniforme* [*C. geophilum*: *R.A.M.*, 21, p. 390; 24, p. 464], on this process was investigated. The roots were grown in the sterilized salt solution of Robbins and White (*Bot. Gaz.*, 98, p. 209, 1936), with the addition of 50 γ aneurin [vitamin B_1]-hydrogen chloride and 500 γ choline chloride per l., in 100 ml. Erlenmeyer flasks. The technique of seed sterilization and root isolation was described in the writer's previous report (*Physiol. Plant.*, 1, p. 278, 1948).

The *B.* spp. stimulated the formation of a considerable number of dichotomous branches, even where no contact had yet been established between the hyphae and the roots. *C. geophilum*, on the other hand, induced only sparse mycorrhizal forking of the roots. Dichotomous branching also occurred in roots grown in the nutrient solution containing exudates of *B. variegatus*. It is concluded that the two *B.* spp. secrete one or more substances which cause dichotomous branching in pine roots, especially the short ones.

Goidànich (G.) & Mezzetti (A.). **Ricerche sulla biologia della Melanospora damnosa (Sacc.) Lindau. II Contributo. Ricerche fisiologiche.** [Researches on the biology of *Melanospora damnosa* (Sacc.) Lindau. Second contribution. Physiological researches.] —*Ann. Sper. agr.*, N.S., 2, 4, pp. 489–514, 1 pl., 1948. [English summary.]

Further studies are described on the strain of *Melanospora damnosa* repeatedly isolated in association with *Fusarium culmorum* from wheat stems in Sardinia [*R.A.M.*, 27, p. 85], the main purpose of the work being to determine the nature of

the heterotrophy shown by the fungus [loc. cit.] and its behaviour when grown in culture, alone and in association with *F. culmorum*.

The results obtained show that *M. damnosa*, in order to grow in culture, requires certain stimulating substances which are present in various plant decoctions, in peptone, and in the mycelium and culture filtrates of *F. culmorum*, and that when grown in association with *F. culmorum* and other *F.* spp. it obtains these substances from them. *M. damnosa* grows as vigorously in media plus staled substrates of *F. culmorum* as it does with the fungus. The stimulating substances, which are required only in small quantities, are synthesized by the fungus in the presence of mineral salts and glucose. Biotin [vitamin H] and aneurin [vitamin B_1] are among these substances, since they promote the complete growth-cycle of *M. damnosa* in a synthetic medium.

The addition of glucose to the media increased rate of superficial growth, density and height of aerial mycelium, and frequency and precocity of fructification in *M. damnosa* up to a certain optimum concentration (about 0·5 per cent.), beyond which (1 per cent.) growth rate and fructification diminished, though not the thickness and height of the mycelium. When, however, *F. culmorum* or its products acted in conjunction with the glucose this reduction did not occur, or it occurred to a less extent, beginning at 1 per cent. glucose concentration. The evidence obtained also indicated that growth of *M. damnosa* may depend on certain as yet undetermined factors.

Doncaster (J. P.) & Gregory (P. H.). **The spread of virus diseases in the Potato crop.**—viii+189 pp., 1 pl., 12 diags., 26 graphs, London, H.M. Stationery Office, 1948. 5*s*.

This study of the epidemiology of leaf roll and rugose mosaic [virus Y] and the degeneration they cause in potatoes in Great Britain is based on counts of aphis populations in the field and on records of the spread of the diseases in potato crops in eastern England from 1940 to 1945 [see next abstracts], supplemented by standard experiments carried out by voluntary collaborators in other parts of England and Wales. The variety Majestic was used in most of the work.

After a preliminary chapter on relationship between planting methods and yield [loc. cit.] the authors summarize the results of observations on the overwintering of the four species of aphides which occur regularly on potato crops, viz., *Myzus persicae*, *Aphis rhamni* [*R.A.M.*, 21, p. 302], which was the predominant species on potatoes in 1940, 1941, and 1942 in eastern and southern England, *Macrosiphum solanifolii*, which does not appear to play any appreciable part in disseminating rugose mosaic and leaf roll, and *Aulacorthum* [*M.*] *solani* which is incapable of transmitting them. Peach trees grown for fruit out-of-doors and in unheated glasshouses were found to be the most important hosts on which *Myzus persicae* overwintered in the egg stage. In some seasons this aphid can persist throughout the year on a succession of *Brassica* crops, but in the severe winters of 1940–1, 1941–2, and 1944–5 survival on these plants was greatly reduced in south-east England. After these winters the numbers on peach and potatoes developed relatively late. The fact that *M. persicae* can migrate from two independent sources may be the reason for the regularity with which this aphis occurs each year in eastern and southern districts. Overwintering of *M. persicae* on sugar beet seed crops was also recorded. *Aphis rhamni* apparently overwinters only in the egg stage and only on *Rhamnus* spp. Even so, heavy infestations sometimes developed on potatoes in the Lincolnshire fens where buckthorn is rare.

In general the infestation of sprouting tubers by *M. persicae* was rare and attacks by this or any other species occurred only if a separate source of infestation existed in close proximity to the potato store. Moreover, routine fumigation of stores with nicotine should prevent such attacks.

Fenland potato fields appeared to provide conditions suitable for the development of entomogenous fungi (mainly *Entomophthora aphidis*) [ibid., 24, p. 207], heavy outbreaks of which were not uncommon. Their effect on aphis populations was often much more severe than that of the braconid parasites, though their occurrence was more localized. They were capable of killing 20 to 30 per cent. of the total peak population under favourable conditions.

On the whole there was a slight positive correlation between the spread of leaf roll and counts of *M. persicae* on the leaves but there is a frequent lack of proportionality between the two. Virus Y, however, showed no apparent relation with numbers of *M. persicae*, but there was only a small number of records available. Spring migrants of *Aphis rhamni* play a part in transmitting virus Y, but their numbers are usually very small in comparison with the spring migrants of *Myzus persicae*.

Wide discrepancies, however, indicated that factors other than the presence of large populations of apterae on the plants, or flights by dispersal migrants as shown by trap records, must play a part in determining the amount of virus transmission. It is certain that spring migrants introduce virus Y and leaf roll into initially healthy stocks, and it is probable that in stocks containing infected plants they are responsible for the early dissemination of the virus already present. Apterae may also play a part at or near the peak of the infestation, especially when interlacing of the foliage facilitates movement between each plant. The winged dispersal migrants of *M. persicae* in summer are believed to play relatively little part in virus transmission. The worst crops were usually those in which a large spread of either virus had occurred early in the season and in which the amount of late spread was not unusually large. Of 106 crops only 11 showed any substantial increase (2 per cent. or more per month) in rugose mosaic after the first week in August because the haulms die early, but 37 of the crops showed late spread of leaf roll.

The probability of a plant becoming infected is greatest in the position adjacent to an infected plant and usually decreases rapidly at increasing distances from an isolated infector plant and less rapidly from a strip or area of diseased plants. When diseased crops are planted adjacent to healthy ones a gradient of infection cannot usually be detected at distances greater than about 10 to 20 rows from the diseased crop. The amount of infection from sources more distant than an adjacent crop is usually slight in comparison with the spread from diseased plants present in the field. When a healthy stock has to be protected from the effects of neighbouring diseased stocks it should be 'insulated' by a barrier of healthy potatotes rather than 'isolated' by bare ground or some other crop.

The effect of fumigating large plots with nicotine vapour was studied from 1942 to 1944. A single treatment early in July was usually successful in destroying aphis infestation but had little effect on the spread of the viruses, presumably because most of the virus transmission had already been effected by winged spring migrants which colonized the crops before July. Volunteer potato plants from a stock derived from healthy seed are usually not an important factor in the degeneration of potato stocks, but survivors from diseased stocks can cause an abnormally large virus increase.

In an emergency rather low yields of reasonably good seed tubers could probably be produced in southern England in normal seasons by a combination of planting healthy stocks; using land free from volunteer plants; choosing varieties of low susceptibility; avoiding urban areas and isolating stocks from diseased crops, gardens, etc.; using large acreages insulated by barriers consisting of good potato crops; roguing plants with secondary virus symptoms and the adjacent plant on each side in the same row; repeated roguing to remove plants with primary virus symptoms; early lifting and wide spacing to give higher yields of seed per ton planted.

Further information is needed to ascertain the relative importance of apterous and alate aphides as vectors and the means by which aphides find their host plants. Aphis infestation and virus spread in early potato varieties, the progress of virus infection in main-crop varieties before tuber formation, and the time taken by each virus to travel from an aphis puncture to the tubers under field conditions are subjects which require further work. Long-term field experiments are needed to study the best rotations and cultivations for eliminating volunteers. Field trials should also test the efficiency of roguing plants with primary symptoms and plants adjacent to infectors.

Broadbent (L.) & Gregory (P. H.). **Experiments on the spread of rugose mosaic and leaf roll in Potato crops in 1946.**—*Ann. appl. Biol.*, 35, 3, pp. 395–405, 1 diag., 4 graphs, 1948.

In this paper are given the 1946 results of the series of co-operative field experiments on the spread of potato rugose mosaic (virus Y) and leaf roll, the results for 1943 to 1945 having been published elsewhere [see preceding abstract].

The incidence of both leaf roll and virus Y was found to increase during the season, but as in previous years a large amount of spread occurred early in the season. Mean values for 13 centres in England and Wales showed that in 1946 69 per cent. of the infections with virus Y and 48 per cent. of those with leaf roll reached the tubers of Majestic potatoes by the beginning of August. At some centres there was an unexplained decline in the percentage of infected tubers taken at the final sampling date. There was usually little increase of virus Y after the beginning of August, but a late increase in leaf roll was associated with a relatively high initial spread. Seventy-five per cent. of the virus Y and 58 per cent. of the leaf roll infections occurred within a distance of five plants from the source.

There was no close relation between the spread of either virus and the maximum number of *Myzus persicae*, either apterous forms on the plants or alatae caught on adhesive traps, but centres with high trap catches in July and August (Askham Bryan, Baston, Postland, Sutton Bonington) showed a pronounced increase in leaf roll in the second half of the season. Over 50 per cent. of the season's spread of both viruses had taken place on the average before the peak of the infestation and the dispersal of summer migrants from the crops, and most of this was present soon after the period of tuber set.

The absence of any considerable increase of virus Y after the initial spread, even at centres with high aphis populations, is further evidence to suggest that alatae are the principal vectors, since most of the plants with virus Y are hidden by healthy plants or are dying by the time alatae are produced within the crop. In 1947, plants showing virus Y were marked at Sutton Bonington on 14th July and dug on 12th August. By the latter date 53 per cent. were dead and 47 per cent. more than half dead, this early death being apparently the result of shading because plants in the open become dwarfed but do not die.

M. persicae was numerous at most of the centres in all years from 1943 to 1946 and is believed to be mainly responsible for transmitting virus Y and leaf roll. Large differences were observed in the proportions of each virus found at different centres in different years. The number of new infections to which a single diseased plant gave rise under the conditions of the experiment varied from 0·06 to 9·6 with virus Y and 0·04 to 10·1 with leaf roll. Aphid counts were evidently insufficient for forecasting the amount of spread of virus disease in a field crop. The traps proved useful in indicating the time of the dispersal of summer migrants from the crop. There was also some relation between the number of *M. persicae* caught on the trap at this time and the size of the population in the field, especially when expressed as number per plant. Trapping is worth while, however, only when the crop cannot be visited at regular intervals.

An examination of the infection gradients for the period 1943 to 1946, at various distances from the virus source, showed a general similarity between the gradients of each virus. When mean values for all years are considered, the gradients of both diseases are somewhat flatter at the beginning than at the end of the season, which suggests that the vectors responsible for late infections tend to move shorter distances than those active earlier in the season. The end-of-season gradient for leaf roll becomes still steeper on applying Thompson's transformation to the data [*R.A.M.*, 28, p. 186].

GREGORY (P. H.). **The effect of roguing on the spread of virus diseases in Potatoes at Rothamsted in 1946.**—*Ann. appl. Biol.*, 35, 3, pp. 406–411, 2 diags., 1948.

Experiments on the effect of roguing virus-diseased plants from plots of Majestic potatoes at Rothamsted, Herts., which have been in progress since 1943 [see preceding abstracts], were continued in 1946. Plots not previously planted with potatoes were set with infected King Edward stock (grown three years in England) surrounded by healthy Majestic and rogued in mid-June and early and late July; plants were lifted at the end of July, August, and September, respectively, and the tubers from these replanted in 1947.

The first *Myzus persicae* was trapped during the first week in June and at the same time the first individuals were found on the potato foliage. Early in July a maximum of 77 per 100 leaves was reached, and a small infestation persisted throughout August. Only four more *M. persicae* were trapped during the rest of the season. Very small infestations of *Aphis rhamni* and *Macrosiphum solanifolii* persisted from July to September.

Roguing had little effect in reducing the spread of rugose mosaic (virus Y). The amount of this virus transmitted was small in comparison with leaf roll and its variability from plot to plot was high. Plots rogued on 14th June and lifted on 27th July showed 9 per cent. leaf roll, about one-quarter of the season's maximum infection, while plots rogued at the same time but lifted on 23rd August and 30th September showed 22·7 and 23·1 per cent. leaf roll, respectively. Roguing on 6th or 27th July resulted in three-quarters of the season's maximum leaf roll infection in July or August crops and the maximum when the tubers were lifted at the end of September (46·9 and 49·4 per cent., respectively). The plots not rogued showed the full season's maximum infection at the August lifting.

These results indicate that a combination of early roguing and early lifting may substantially reduce the amount of leaf roll in a crop grown specially for 'seed'. The results, however, confirm the conclusion reached in previous years that roguing diseased plants arising from infected tubers is of little value in improving seed tubers from ware crops in the south of England, owing to the substantial loss in yield sustained from lifting in July and because symptoms have seldom developed sufficiently to allow roguing in mid-June. This does not apply to 'seed'-growing areas in which roguing has long been practised and has led to a valuable improvement of potato stocks.

BERKELEY (M. J.). **Observations, botanical and physiological, on the Potato murrain.**—*Phytopath. Class.* 8, 108 pp., 6 pl., 1948.

This classical paper on potato blight [*Phytophthora infestans*], with reproductions of five original plates, has been reprinted by the American Phytopathological Society to commemorate the centenary of its original publication. It is preceded by a biographical note by J. Ramsbottom, and included in the volume are extracts from Berkeley's 'Vegetable Pathology', selected by the Plant Pathology Committee of the British Mycological Society. This latter work appeared originally as a series of 173 articles in the *Gardeners' Chronicle and Agricultural Gazette* in the years 1854 to 1857.